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The Spaceplane: The Catalyst for Resolution of the Boundary and 'Space Object' Issues in the Law of Outer Space?

by

Elizabeth Kelly

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements of the degree of Master of Laws (LL.M.)

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The conclusions expressed are those of the author. They are not intended and should not be thought to represent official ideas, attitudes, or policies of any agency of the United States Government. The author has not had access to information not otherwise releasable to the public and has employed only material available to any writer on this subject.

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ABSTRACT

The spaceplane could be the most desirable form of space transportation in the next century. However, accompanying it are questions of whether a boundary is needed between airspace and outer space, and whether the current definition of 'space object' in the outer space treaties is adequate to include these hybrid vehicles. This thesis concludes that the spaceplane does not portend the need for a boundary and that it will not require the development of a new definition. Chapter I describes some of the best known spaceplane initiatives. Chapters II and III, respectively, discuss the air law and space law regimes and arguments made for and against establishing a boundary between airspace and outer space. Chapter IV describes debates regarding the sufficiency of the term 'space object' as it is defined in the space law regime. Chapter V analyzes the impact that spaceplanes will have on the boundary and 'space object' debates.

RÉSUMÉ

L'avion spatial pourrait être la façon de transport spatial la plus désirée au XXIème siècle. Toutefois, cette forme de transport soulève des questions, à savoir, si une démarcation est nécessaire entre l'espace aérien et l'espace extra-atmosphérique, et si la définition actuelle de l' 'objet spatial' dans le droit spatial est adéquate pour inclure des appareils hybrides. La présente thèse arrive à la conclusion que l'avion spatial n'exige aucune démarcation et que l'élaboration d'une nouvelle définition n'est pas nécessaire. Le Chapitre I décrit quelques-unes des initiatives de l'avion spatial qui sont les mieux connues. Les Chapitres II et III, respectivement, traitent les régimes du droit du transport aérien et du droit spatial ainsi que les arguments en faveur et contre l'établissement d'une démarcation entre l'espace aérien et l'espace extra-atmosphérique. Le Chapitre IV décrit les débats concernant la suffisance du terme 'objet spatial' tel que défini dans le cadre du régime du droit spatial. Le Chapitre V analyse l'impact qu'auront les avions spatiaux sur les débats de la démarcation et de l' 'objet spatial.'

ACRONYMS AND ABBREVIATIONS

AIAA	American Institute of Aeronautics and Astronautics
AMSC	Advanced Military Space Flight Capability
Ann. Air & Sp. L.	*Annals of Air and Space Law*
Avatar	Aerobic Vehicle for Advanced Trans-Atmospheric Research
AW&ST	*Aviation Week & Space Technology*
BAe	British Aerospace
BMDO	Ballistic Missile Defense Organization
Bus. Wk.	*Business Week*
cf.	Compare (Latin: *confer*)
CNES	Centre National d'Etudes Spatiales
COPUOS	Committee on the Peaceful Uses of Outer Space
C.T.S.	Consolidated Treaty Series
D.C.L.J. Int'l L. & Prac.	*Detroit College of Law Journal of International Law & Practice*
DC-X	Delta Clipper—Experimental
DLR	German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt)
Doc.	Document
DoD	Department of Defense
ed.	Editor
ELV	Expendable Launch Vehicle
ESA	European Space Agency
FAA	Federal Aviation Administration
FESTIP	Future European Space Transportation Investigation Program
Flight Int'l	*Flight International*
GAO/NSIAD	General Accounting Office, National Security and International Affairs Division
HIMES	Highly Maneuverable Experimental Space Vehicle
HOPE	H-2 Orbiting Plane
HORUS	Horizontal Orbital Upper Stage
HOTOL	Horizontal Takeoff and Landing
HTOL	Horizontal Takeoff/Horizontal Landing
ICAO	International Civil Aviation Organization
ICBM	Intercontinental Ballistic Missile
I.C.J. Rep.	*International Court of Justice Reports*
ILA	International Law Association
Int'l	International
Int'l Def. Rev.	*International Defense Review*
J. Sp. L.	*Journal of Space Law*
KAL	Korean Airlines
km	Kilometer

Law. Co-op.	Lawyers Cooperative Publishing
LEO	Low Earth Orbit
LL.M.	Master of Laws
L.N.T.S.	League of Nations Treaty Series
MAV	Military Aerospace Vehicle
Mil. L. Rev.	*Military Law Review*
Mil. Sp.	*Military Space*
NAL	National Aerospace Laboratory
NASA	National Aeronautics and Space Administration
NASDA	National Space Development Agency
NASP	National Aerospace Plane
Netherl. Int'l L. Rev.	*Netherlands International Law Review*
NPO	Scientific Production Association
NSTS	National Space Transportation System
OOSA	Office of Outer Space Affairs
para.	Paragraph
P.L.	Public Law
PREPHA	Programme de Recherche en Propulsion Hypersonique Avancée
Rep.	Report
Res.	Resolution
RLV	Reusable Launch Vehicle
SSTO	Single-Stage-to-Orbit
STAR-H	Systeme de transport spatiale aerobie re-utilizable horizontale
Stat.	Statutes
STS	Space Transportation System
Subcomm.	Subcommittee
Sup. Ct.	Supreme Court
TAV	Transatmospheric Vehicle
T.I.A.S.	Treaties and Other International Acts Series
TSTO	Two-Stage-to-Orbit
U.C.	University of California
U. Colo. L. Rev.	*University of Colorado Law Review*
U.K.	United Kingdom
U.N.	United Nations
U.N.G.A.	United Nations General Assembly
Univ.	University
U.N.T.S.	United Nations Treaty Series
U.S.	United States
USAF	United States Air Force
U.S.C.S.	United States Code Service
USSR	Union of Soviet Socialist Republics
U.S.T.	United States Treaty Series
VTHL	Vertical Takeoff/Horizontal Landing
VTOL	Vertical Takeoff/Vertical Landing

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INTRODUCTION

Possibly the most far-fetched idea
since the airplane.
--Lockheed Martin[1]

The idea of a spacecraft that could take off and land like conventional aircraft, transport humans and cargo into space, and transport humans and cargo from one point on earth to any other point on earth at hypersonic[2] speeds has been around for decades.[3] Sometimes referred to as transatmospheric vehicles, rocketplanes, and aerospace planes, spaceplanes[4] with these capabilities have not yet moved beyond the experimental phase. It appears that a lack of sufficient funding to develop the necessary propulsion technology is the major reason why no operational spaceplane exists today. Nevertheless, interest in developing spaceplanes remains high around the world. The United States Air Force desires to have a spacecraft in its arsenal that should enable it to expand its space activities. The U.S. National Aeronautics and Space Administration wants to develop a spaceplane that could replace its aging, and costly, space shuttle orbiters. Space agencies in Japan, Europe, and India also have considered spaceplane concepts to boost their own space activities and to use as a less expensive alternative to the current launch vehicles. Even some private aerospace companies are funding spaceplane development initiatives in an effort to facilitate and expand their access, and the access of other private entities, to space.

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[1] Lockheed Martin Corp., Advertisement for the VentureStar/X-33, *AW&ST* (15 June 1998) 7.

[2] 'Hypersonic' is defined as "a range of speed that is five times or more the speed of sound in air." Report of the United States General Accounting Office, "Aerospace Plane Technology—Research and Development Efforts in Japan and Australia," GAO/NSIAD-92-5 (Oct. 1991) at Glossary [hereinafter GAO/NSIAD-92-5]. A 'Mach number' is "a number representing the ratio of the speed" of the vehicle to that of sound. *Id.* Thus, hypersonic speed is speed in excess of Mach 5.

[3] J. Grey, "Will Aerospace Plane Go International?" *Aerospace America* (July 1993) 16.

[4] For consistency purposes, this thesis will refer to all these types of vehicles as 'spaceplanes.'

States with plans for civil, military, and/or commercial spaceplanes should be aware, however, that these instrumentalities, with their aircraft-like qualities, will raise some important, long-standing, and still unresolved questions of the outer space legal regime. Among these questions, the most important as well as controversial are the issues of whether there should be a boundary between airspace and outer space, and whether a definition of the term 'space object' is necessary—both explored in this thesis. Chapter I describes spaceplane initiatives of the past and present, outlining the desired characteristics, potential users, and the potential uses for these spacecraft. Chapter II discusses the existing air and space legal regimes as they pertain to the issues raised by the lack of a boundary between airspace and outer space. Chapter III explores the arguments that have been raised for and against the establishment of a boundary. The legal regime concerning 'space objects' and the issues raised by attempts to define what constitutes a 'space object' are covered in Chapter IV. Chapter V analyzes the impact that operational spaceplanes will have on the 'space object' and boundary questions.

CHAPTER I

The Spaceplane and its Potential Uses and Users

There is no single, authoritative definition of the term 'spaceplane.' For purposes of this thesis, 'spaceplane' refers primarily to winged, hybrid transportation vehicles capable of performing sustained operations both in the atmosphere and outer space,[5] but also includes winged spacecraft used solely for earth-to-orbit missions or solely for earth-to-earth operations. Excluded from this definition are rockets whose sole function is to perform as launch vehicles.

Spaceplane concepts propose varying vehicle configurations. The propulsion configurations fall into one of three categories: single-stage-to-orbit (SSTO), two-stage-to-orbit (TSTO), or multi-stages. An SSTO vehicle has an integrated propulsion system, and has no parts, or 'stages,' that separate from the vehicle during its ascent. TSTO and multi-stage vehicles have two or more separate propulsion systems or stages, either reusable or expendable, which usually separate from the vehicle during its ascent. While the SSTO configuration is considered to be the most desirable in light of its potentially lower life cycle cost, the TSTO configuration is currently considered the more technically feasible.[6] Spaceplanes are also described according to the method they use for takeoff and landing. These three configurations are referred to as vertical takeoff/vertical landing (VTOL), vertical takeoff/horizontal landing (VTHL), and horizontal takeoff/horizontal landing (HTOL).

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[5] As one space expert puts it, "[t]he spaceplane . . . is not a technology system with only one concept, but a technology with dual concepts" – surface-to-surface and surface-to-outer space. Y. Hashimoto, "The Space Plane and International Space Law," *Proceedings of the Thirty-fifth Colloquium on the Law of Outer Space* (Washington, D.C.: AIAA, 1993) 378 [hereinafter Hashimoto].

[6] *See, e.g.*, ESA Publication, *Reaching for the Skies*, Number 15, "Reusable Launchers: Why Do System Concept Studies Now?" http://esapub.esrin.esa.it/rfs/rfs15/duja15.htm (accessed: 9 June 1998) [hereinafter *Reaching for the Skies*]; *see also* J.R. Asker, "Debates Roil X-33 Effort," *AW&ST* (18 Sept. 1995) 21 (pointing out that the Department of Defense would prefer SSTOs because they would be cheaper and more efficient than TSTOs, and, therefore, would be used more often).

A driving force behind spaceplane development is the desire for less expensive and quicker access to space. Most launches employ rockets, which are also known as 'expendable launch vehicles' (ELVs). But ELVs are considered "inflexible, cumbersome, nonmaneuverable, [and] dangerous, and require[] extensive facilities and manpower to operate."[7] The need to use a new ELV for each launch increases the costs for access to space. Thus, most spaceplanes are conceived to be fully reusable, although some of the multi-stage vehicles might have a small expendable stage.

Because they will need to reach a speed of at least Mach 25 in order to enter orbit,[8] all hybrid spaceplanes will be hypersonic. In addition, they generally will have wings, giving them an aircraft-like appearance. Lastly, one of the anticipated benefits of HTOL spacecraft is their ability to use conventional airport runways.

A. Potential Uses for Spaceplanes

One future use for spaceplanes that immediately comes to mind is global passenger and cargo transport. Rather than transporting passengers and cargo from New York to Tokyo on the average 16 hours, a spaceplane would complete the same trip in less than two hours.[9] Distinguishing the spaceplane from such supersonic aircraft as the Concorde is the spaceplane's ability to travel at hypersonic speeds and to conduct part of the trip in space.[10] Because the expense of transporting anything at

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[7] A.J. Parrington, "U.S. Space Doctrine—Time for a Change?" *Air Power Journal* (1989), http://www.cdsar.af.mil/apj/apj89/parring.html (accessed: 29 Apr. 1998).

[8] Federation of American Scientists, Intelligence Resource Program—Mystery Aircraft, "X-30 National Aerospace Plane (NASP)," http://www.fas.org/irp/mystery/nasp.htm (accessed: 25 Apr. 1998) [hereinafter "Mystery Aircraft"].

[9] S. Gorove, *Developments in Space Law* (The Netherlands: Kluwer, 1991) 355 [hereinafter Gorove]; R. Zubrin and M.B. Clapp, "Aviation's Next Great Leap—Rocket-Powered Aircraft That Can Travel at Hypersonic Speeds," *Technology Review* (11 Jan. 1998) 30 [hereinafter, Zubrin]; H.L. van Traa-Engelman, *Commercial Utilization of Outer Space—Law and Practice* (The Netherlands: Kluwer, 1993) 73 [hereinafter van Traa-Engelman].

[10] I.H.Ph. Diederiks-Verschoor, *An Introduction to Space Law* (The Netherlands: Kluwer, 1993) 76 [hereinafter *Introduction to Space Law*]; van Traa-Engelman, *supra* note 9.

hypersonic speeds is likely to be high initially, personal travel and shipping via spaceplanes are probably decades away.[11]

Nevertheless, the humanitarian benefits of spaceplane transport cannot be overlooked as an important incentive for developing this technology. For example, the United Nations could benefit from the ability to more quickly respond to crises by hypersonically transporting peacekeeping forces, medical supplies, food, and other support. In addition, doctors with specialized medical skills could be flown swiftly anywhere in the world to provide critical care or surgery in highly deserving cases.

Another incentive for spaceplane development would be its usefulness in enabling states to realize the promise of the International Space Station. Currently, there are only two operational space transportation systems—the U.S. Space Shuttle Orbiters and the Russian Soyuz spacecraft. Other states, and even private entities, could benefit from the availability of spaceplanes for the rapid transport of scientists, experiments, and supplies to and from the space station. Moreover, it is possible that more plans would materialize to use the space station for materials processing, pharmaceutical development, and other projects that could benefit from a microgravity environment, if a less expensive and quicker means of transportation was available.

An important issue of concern to many in the space law community and to environmentalists is the matter of the large amount of debris that is accumulating in outer space. This space debris could be anything from dead satellites to non-useful component parts of man-made space objects. The high rates of speed at which these objects travel while in space render even the smallest particle of debris a hazard to functioning satellites and spacecraft. Because spaceplanes will be more flexible and less expensive to launch than the space shuttle, they could be used for missions to clean up this debris.

A more immediate use for spaceplanes is rapid satellite launch. With the current plans of several commercial entities to place large constellations of

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[11] Zubrin, *supra* note 9.

telecommunications satellites into low earth orbit,[12] spaceplanes would be the ideal launch vehicle. Spaceplane designs typically incorporate technology that will enable the vehicle to be reused within hours, rather than weeks.[13] For those spaceplanes with the ability to take off horizontally from any conventional airport runway, customers will not be limited to the relatively few vertical launch sites currently in existence. They will be able to launch their satellites from almost anywhere in the world. Moreover, most spaceplane designs propose fully reusable vehicles. Currently, launch vehicles such as Delta, Atlas, Titan, Proton, and Ariane use expendable boosters. Hence, new vehicles are required for each launch, which renders each launch a very expensive activity.[14] These conveniences are the major factors that render the development and production of operational spaceplanes so attractive—they will make launches much more cost-effective. They will also facilitate the quick repair, retrieval, and replacement of satellites,[15] and the rapid repair of elements of the International Space Station.

In addition to civil applications, spaceplanes could serve several military purposes. The U.S. military has expressed interest in a vehicle that is capable of

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[12] *See, e.g.*, J.C. Anselmo, "Ready to Go," *AW&ST* (27 Oct. 1997) 17 (Motorola's Iridium constellation will have 66 satellites, plus spares; Loral's Globalstar constellation will have 48 satellites, with 8 spares); M.A. Dornheim, "Vandenberg Launches Eight Satellites," *AW&ST* (23 Feb. 1998) 41 (Orbital Communications Corporation's Orbcomm system will have an initial constellation of 28 satellites); B.A. Smith, "Operational Iridium Constellation in Place," *AW&ST* (25 May 1998) 26 (ICO Global Communication plans to launch a 12-satellite constellation); B.A. Smith, "Motorola Begins to Work on Teledesic Design Requirements," *AW&ST* (1 June 1998) 25 (Motorola's Teledesic constellation—a project previously spearheaded by Boeing Corporation--will contain 288 satellites, a decrease from the 900 satellites initially proposed); M.A. Taverna, "SkyBridge Expands LEO Network," *AW&ST* (15 June 1998) 69 (Alcatel's SkyBridge will have 80 satellites).

[13] Whereas the U.S. Space Shuttle Orbiters require a minimum of 30 days between use, spaceplanes will have a turnaround time of about 72 hours or less. G.T. Pope, "Space Race 2000—Space Travel," *Popular Mechanics* (Mar. 1992) 24 [hereinafter Pope].

[14] The cost of transporting a payload into orbit on these vehicles averages between $10,000 and $20,000 per kilogram. Zubrin, *supra* note 9. Thus, it is estimated that it costs approximately $15 million per satellite to launch up to six satellites on a Lockheed Martin Atlas IIA, and approximately $23 million to launch a satellite on an Orbital Sciences Taurus. *Id.* In contrast, it is estimated that spaceplanes will launch satellites for a total cost of $4 - 8 million. *Id. See also* W.B. Scott, "McPeak, Hecker Head 'Space-Plane' Project," *AW&ST* (10 Mar. 1997) 22 [hereinafter "McPeak, Hecker"].

[15] Zubrin, *supra* note 9.

"observing, intercepting, and striking an enemy's aircraft" from space.[16] A spaceplane could also perform reconnaissance missions from space, and could launch military satellites. Just as with civil spaceplanes, military spaceplanes could be used for rapid repair and retrieval of satellites. Furthermore, spaceplanes could serve as a more cautious means of launching nuclear warheads. Unlike current methods of launching these objects, a spaceplane carrying such weapons could be halted prior to dropping the warhead, in case there is a last minute decision to change the plan of attack.[17] Thus, spaceplanes can be used as strategic bombers, which, due to their hypersonic speeds, could travel faster than a ballistic missile.[18] And, of course, spaceplanes could be used to transport military personnel, and for other airlift purposes.

B. Spaceplane Development Programs

A paper published in 1944 by German scientists Eugen Sänger and Irene Bredt was made available to the rest of the world following the end of World War II. Envisioning a winged, rocket-powered, hypersonic aircraft that "could be boosted into orbit and then glide back to Earth," Sänger and Bredt are credited with revolutionizing the way aeronautics experts began to view the prospects for manned hypersonic travel.[19] Many spaceplane projects are derived from their work, but with the exception of the U.S. Space Shuttle Orbiter, few of them have moved beyond the research phase. Following is a discussion of some of the better-known spaceplane projects.

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[16] *Id.*

[17] *Id.*

[18] Pope, *supra* note 13.

[19] R.P. Hallion, *On The Frontier* (1984) at Chapter 6.3, http://www.dfrc.nasa.gov/History/Publications/SP-4303/ch6.3.html (accessed: 7 May 1998).

1. *United States*

Copious information is available indicating that the United States has been ahead of the rest of the world in the development of a spaceplane.[20] Most of its projects have been government efforts, but recently, several commercial projects have surfaced.

a. The X-15

Work on a spaceplane was one of the first projects of the fledgling National Aeronautics and Space Administration (NASA) in the 1950s and 1960s. Early success came with the rocket-powered, winged X-15 ('X' for experimental) spaceplane, first conceived in 1954.[21] The purpose of the X-15 was to "provide data on aerodynamics, structures, flight controls and the physiological aspects of high-speed, high altitude flight."[22] With input from the Air Force and the Navy, NASA developed three hypersonic X-15 vehicles that made a total of 199 flights between 1959 and 1968.[23] Launched from B-52 bomber aircraft, and travelling at speeds of up to Mach 6.7, the X-15 skimmed the outer edges of space, reaching altitudes as high as 354,200 feet.[24]

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[20] Because of the potential national security and military uses for spaceplanes, some defense watchers speculate that the Department of Defense engages in classified spaceplane technology development, and that, therefore, the true extent of U.S. spaceplane activity may never be known. *See, e.g.*, B. Sweetman, "Black and White: The USAF's Secret Programs," *Int'l Def. Rev.—Extra* (1 Nov. 1997) 1; W.B. Scott, "U.S. Defines Missions for Military Spaceplane," *AW&ST* (13 Jan. 1997) 362 (*AW&ST* "has evidence that the intelligence community has been pursuing a highly classified spaceplane project for several years.") [hereinafter "Missions"]; S.J. Mraz, "Trouble in Aerospace Paradise," *Machine Design* (8 Mar. 1990) 66 [hereinafter Mraz].

[21] "Lifetime Achievement," *AW&ST* (13 Apr. 1998) L13 [hereinafter "Lifetime Achievement"]; S. Chapman, "The Spaceplane," *Air Force Magazine* (Mar. 1997) 62 [hereinafter Chapman]. NASA's predecessor, the National Advisory Committee for Aeronautics, started the project.

[22] P. McKenna, "The X Flies—Air Force studies experimental spaceplanes," *Airman Magazine* (June 1997) http://www.af.mil/news/airman/0697/rocket2.htm (accessed: 8 Feb. 1998) [hereinafter McKenna].

[23] Chapman, *supra* note 21.

[24] "Lifetime Achievement," *supra* note 21 (The top speed of Mach 6.7 was reached in October 1967 by Pete Knight.); Chapman, *supra* note 21; *see also* American Bar Foundation, *The Law Relating to Activities of Man in Space* (Chicago: The Univ. of Chicago Press, 1970) 16 (Mach 6.7 is

Like most experimental vehicles, the X-15 was not taken into space; nevertheless, the altitudes reached were often high enough to earn some of the pilots astronaut wings.[25]

b. The X-20

Development of the X-15 heightened the U.S. Air Force's interest in adding a spaceplane to its arsenal. The Air Force used the knowledge gained from participation in that program to start its own experimental military spaceplane program in 1957, the X-20.[26] Originally known as the Dyna Soar,[27] the X-20 was designed to be a manned, winged glider that would be used to test the "lifting" that spaceplanes would experience upon reentry into earth's atmosphere.[28] The X-20 was to be launched vertically from an intercontinental ballistic missile (ICBM) booster whose trajectory would be modified so that the vehicle glided to a controlled, horizontal landing.[29] The program was cancelled in 1963, prior to actual construction of a vehicle, because the government

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approximately 4,500 mph; 354,200 feet is approximately 67 miles.) [hereinafter American Bar Foundation].

[25] "Lifetime Achievement," *supra* note 21 (Reaching an altitude of 264,000 feet (50 miles) qualified pilots as astronauts.); *see also* American Bar Foundation, *supra* note 24.

[26] Chapman, *supra* note 21; "Air Force/NASA Lifting Body Legacy History Project" (31 July 1997) at Appendix A, http://www.patprojects.org/LiftingBody/ap_a_1.htm (accessed: 7 May 1998) [hereinafter "Lifting Body Legacy"].

[27] "Dyna Soar" is an homage to Dr. Sänger, who referred to the flight capability of his hypersonic aircraft concept as "dynamic soaring." *See* "Lifting Body Legacy," *supra* note 26, at Appendix A.

[28] *Id.*

> A lifting entry is one in which the primary force being generated is perpendicular to the flight path, that is, a 'lift' force. Although drag is present throughout the entry, the resulting flight path can be adjusted continuously to change both vertical motion and flight direction while the velocity is slowing. The gliding flight of a sailplane is an example of "lifting" entry without high velocities and heating. . . . One of the advantages foreseen for a lifting entry vehicle was the high probability that the vehicle could be landed like a normal glider after completing the entry. This would eliminate the need for parachutes or other 'decoupled mode' recovery concepts.

Id. at Chapter 1.5. The United States Air Force and the National Aeronautics and Space Administration tested several different lifting-body aircraft for a number of years.

[29] *Id.* at Appendix A. Because ICBM rocket engines had not been rated safe for manned flights at the time, the design was later changed to incorporate a Titan III booster. *Id.*

determined that it duplicated NASA's manned spaceflight program.[30] Nevertheless, the data gained from the program was used in later civilian and military spaceplane projects.

c. The Space Shuttle

Data gained from the X-15 and X-20 flights was applied towards the development of NASA's space shuttle in the early 1970s. One of the initial concepts for the space shuttle envisioned it as a fully reusable single-stage-to-orbit (SSTO), horizontal takeoff and horizontal landing (HTOL) vehicle.[31] Because propulsion technology had not yet developed to the point that an SSTO/HTOL configuration was feasible, NASA opted for its current multi-stage configuration.[32]

The first shuttle was launched on 12 April 1981.[33] The shuttle takes off vertically, powered by two reusable solid propellant rocket boosters (first stage) and an expendable external fuel tank (second stage), all of which separate from the shuttle prior to its entry into orbit. The two orbital maneuvering system engines (third stage), which activate to push the shuttle into orbit, are also responsible for preserving enough fuel to propel the shuttle out of orbit.[34]

One characteristic that distinguishes the shuttle from previous manned spacecraft like the Soviet Vostok and Voskhod vehicles; and the American Mercury, Gemini, and Apollo vehicles; is its reusability due to its ability to return to earth as an

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[30] National Air and Space Museum, "Space Race," Section 540, "Space Shuttle: First Reusable Spacecraft," http://www.nasm.edu/GALLERIES/GAL114/SpaceRace/sec500/sec540.htm (accessed: 7 May 1998) [hereinafter "Space Race"].

[31] *Id.*

[32] *Id.*

[33] "Space Shuttle," *Grolier Multimedia Encyclopedia,* CD-ROM (Danbury, CT: Grolier, Inc., 1996) [hereinafter *Grolier*]. There are four space shuttle orbiters in service: Columbia, Discovery, Endeavour, and Atlantis. *Id.*

[34] *Grolier, supra* note 33; "Space Shuttle," *Microsoft Encarta 97 Encyclopedia,* CD-ROM (Microsoft Corp., 1993-1996) [hereinafter *Microsoft Encarta*].

aircraft. The shuttle orbiters are designed to be reused for up to 100 times each.[35] The shuttle lands horizontally by gliding--unpowered, but under control--onto a designated, specially designed runway.[36] Upon reentering the earth's atmosphere, the shuttle orbiter "has a cross-range maneuvering capability of 1,100 nautical miles (1265 statute miles)."[37] Service and maintenance work enable the shuttle to be ready for reuse within 30 days.[38]

The shuttles transport both civil and military payloads. However, since 1986, U.S. policy has prohibited commercial payloads from being carried on the space shuttle if the payloads can be launched by unmanned vehicles instead.[39]

d. SCIENCE DAWN and SCIENCE REALM

SCIENCE DAWN was a classified U.S. Air Force program for a sled-launched HTOL SSTO launch vehicle. Difficulty designing the vehicle so that its rocket thrust-to-weight ratio could support a horizontal takeoff contributed to cancellation of the program in 1986.[40] SCIENCE REALM was the 1986 follow-on to SCIENCE DAWN. In light of the problems SCIENCE DAWN encountered with its horizontal takeoff

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[35] *Microsoft Encarta, supra* note 34.

[36] The shuttle usually lands at either Cape Canaveral Air Station in Florida, or at Vandenberg Air Force Base, California. Other landing sites in the U.S. include Edwards Air Force Base in California, and White Sands Missile Range in New Mexico. *NSTS 1988 News Reference Manual*, http://www.ksc.nasa.gov/shuttle/technology/sts-newsref/sts_lcc.html#sts-ksc-slf (accessed: 6 May 1998) [hereinafter *NSTS Reference Manual*]. NASA has also entered into bilateral agreements with several countries to allow emergency/contingency landing of the shuttle within their territories. *See, e.g.*, Agreement Between the U.S. and France on Space Cooperation: Shuttle Contingency Landing Site (6 Sept. 1984) T.I.A.S. No. 11163; Agreement Between the U.S. and Spain on Space Cooperation (4 Sept. 1984) T.I.A.S. No. 11067; Agreement Between the U.S. and Chile on Space Cooperation: Shuttle Contingency Landing Sites (2 Aug. 1985) No. T.I.A.S. 11248 [hereinafter U.S.-Chile Space Cooperation Agreement].

[37] *NSTS Reference Manual, supra* note 36.

[38] Pope, *supra* note 13.

[39] J.C. Anselmo, "NASA to Seek Major Shift in U.S. Shuttle Policy," *AW&ST* (13 Oct. 1997) 26.

[40] Federation of American Scientists, Intelligence Resource Program—Mystery Aircraft, "SCIENCE DAWN," http://www.fas.org/irp/mystery/science_dawn.htm (accessed: 16 July 1998).

design, SCIENCE REALM focused on a vertical takeoff design.[41] No operational spaceplane resulted from this project.

e. The National Aerospace Plane, or the X-30

In 1986, President Ronald Reagan revealed that the U.S. was working on a vehicle that not only would be capable of travelling hypersonically to opposite sides of the earth in less than two hours (the 'Orient Express'), but would also be capable of travelling into low earth orbit to perform space missions.[42] It is believed that, up to the point of that announcement, the vehicle, called the National Aerospace Plane (NASP), had been a classified program known as Copper Canyon that was overseen by the Defense Advanced Research Projects Agency from 1982-1985.[43]

In 1985, responsibility for the program was transferred to NASA, which would be assisted by the Department of Defense in the development of the vehicle.[44] NASA redesignated the program the X-30, and stated that the goal of the program was to develop a flight research vehicle that would be used to "validate a wide range of aerospace technologies and capabilities, including horizontal take-off and landing, single-stage operation to orbital speeds and sustained hypersonic cruise within the atmosphere using airbreathing propulsion."[45] It was hoped that the X-30 would lead to the development of the next-generation space shuttle, and to the development of hypersonic aerospace vehicles and long-range air defense interceptors that could travel

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[41] Federation of American Scientists, Intelligence Resource Program—Mystery Aircraft, "SCIENCE REALM," http://www.fas.org/irp/mystery/science_realm.htm (accessed: 16 July 1998).

[42] P. Gray, "Airpork—The National Aero-Space Plane is Too Fast to Live, Too Hyped to Die," *Washington Monthly* (July 1991) 37.

[43] "Mystery Aircraft," *supra* note 8.

[44] Mraz, *supra* note 20.

[45] NASA SpaceLink News Release 88-129, "9/20/88: NASA Marks Thirtieth Anniversary on October 1," http://spacelink.msfc.nasa.gov/NASA.News/NASA.News.Releases/Previous.News.Releases/88.News.Releases/88-09.News.Releases/88-09-11 (accessed: 29 Apr. 1998) 5 [hereinafter "SpaceLink News Release 88-129"]; *see also* Mraz, *supra* note 20.

through both the atmosphere and space.[46] The reuse turnaround period for the X-30 was predicted to be 24-72 hours.[47] It should be noted that the X-30's ability to take off horizontally meant that it would travel through the navigable airspace for a longer period of time than the space shuttle.[48]

Considered critical to successful development of the X-30 was the creation of an airbreathing propulsion system, called a scramjet, that could reach a speed of at least Mach 25 to reach orbit.[49] But developing an engine that could reach Mach 25 without assistance from rockets was more difficult than NASA expected, therefore, small rockets were added to the design.[50] Unfortunately, additional technological difficulties, mounting costs, and budget cuts led to cancellation of the program in 1994.[51]

f. The DC-X

In 1990, the Ballistic Missile Defense Organization, then known as the Strategic Defense Initiative Organization, initiated a project--managed by the Air Force--designed to "demonstrate the practicality, reliability, operability, and cost efficiency of a fully reusable, rapid turnaround single stage rocket, with the ultimate goal of aircraft-like operations of reusable launch vehicles (RLVs)."[52] The goal was to gain data that

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[46] "SpaceLink News Release 88-129," *supra* note 45.

[47] "Mystery Aircraft," *supra* note 8.

[48] J. Rosen, "Spaceplanes Get Ready For Takeoff," *Mechanical Engineering-CIME* (July 1991) 72 [hereinafter Rosen].

[49] J. Haggerty, "The real aerospace plane," 2 *Sp. Policy* 355 (Nov. 1986). A scramjet is an airbreathing supersonic combustion ramjet which would "compress onrushing hypersonic air in a combustion chamber. Liquid hydrogen is then injected into the chamber, where it is ignited by the hot compressed air. The exhaust, consisting primarily of water vapor, is expelled through a nozzle to create thrust." "Mystery Aircraft," *supra* note 8.

[50] NASA SpaceLink Fact Sheet, "National Aero-Space Plane Fact Sheet," (Jan. 1993) http://spacelink.nasa.gov/t?NASA.Projects/Aeronautics/High.Performance.Aircraft.and.Research/X-30.National.Aeropsace.Plane/Fact.Sheet (accessed: 8 Feb. 1998).

[51] Chapman, *supra* note 21.

[52] BMDO DC-X Fact Sheet, http://www.hq.nasa.gov/office/pao/History/x-33/dcx-facts.htm (accessed: 7 May 1998) [hereinafter "DC-X Fact Sheet"].

could be used to develop a vehicle able to travel into space, return to the launch site, and be readied for reuse within three days.[53] The experimental vehicle, called the Delta Clipper, or DC-X, was configured for vertical takeoff and vertical landing.[54] The DC-X's landing was rocket-powered, thus, it did not glide like the space shuttle.[55]

Although the DC-X only flew at suborbital altitudes,[56] its test flights provided data on the effects of rocket-powered vertical landings on hard surfaces.[57] In 1995, after a number of successful flights, the program was transferred to NASA, which renamed it DC-XA.[58] The DC-XA incorporated new technological advancements, such as a rocket fuel composition that reduced the vehicle's weight.[59] The data gained from the DC-XA was used in the development of a new NASA spaceplane, the X-33. The DC-XA has not flown since July 1996, when it exploded after a landing.[60]

g. The X-33

In 1994, NASA started the X-33 program, hoping to develop a fully reusable SSTO/VTHL vehicle.[61] It is expected that the absence of an external fuel tank will help make the X-33 less expensive to launch than the space shuttle.[62] For example, it has

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[53] *Id.* The actual turnaround achieved was about 24 hours. *See* "The Legacy of Clipper Graham," *Aerospace America* (Oct. 1997) 26 [hereinafter "The Legacy"]; McKenna, *supra* note 22.

[54] "DC-X Fact Sheet," *supra* note 52.

[55] *Id.*

[56] *Id.*

[57] "The Legacy," *supra* note 53.

[58] Phillips Laboratory Press Release #95-51, "DC-X Rotates Its Nose For a Successful Test" (7 July 1995) http://www.hq.nasa.gov/office/pao/History/x-33/phillips-95-51.htm (accessed: 7 May 1998).

[59] *Id.*

[60] Chapman, *supra* note 21.

[61] *Id.*

[62] "NASA OKs Design for Space Plane," *The Salt Lake Tribune* (1 Nov. 1997) http://www.sltrib.com/97/nov/110197/nation_w/4955.htm (accessed: 10 Mar. 1998).

been estimated that a fully operational X-33 vehicle could lower launch costs to approximately $1,500/pound, a substantial decrease from the approximately $8,300/pound it now costs to launch payloads on manned spacecraft.[63] Lockheed Martin Corporation is currently building a half-scale X-33 prototype, and plans to have it ready for test launches in 1999.[64] Thus, the X-33 is the first U.S. spaceplane since the space shuttle to move beyond the research stage.

h. Other NASA Projects

NASA, which has primary responsibility in the U.S. for development of government reusable launch vehicles (RLVs),[65] is working on several other spaceplane concepts. Programs such as the Hyper-X and X-34 are intended to provide information to help in the further development of hypersonic spaceplane technology. These programs are not intended to lead to prototypes for fully operational vehicles.[66]

Buoyed by what looks to be a successful X-33 program, NASA is already planning for an RLV that would be even more advanced than the full-scale X-33. This new program is called Future-X, and NASA hopes to begin soliciting proposals from aerospace contractors for further research and development on the program in the latter part of 1998.[67] NASA states that while the "X-33 is a demonstrator for Earth-to-

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[63] "Estes: Military Spaceplane Requires New Tech," *Mil. Sp.* (8 Dec. 1997) [hereinafter "Estes"].

[64] *Id.*; L. Siegel, "Made in Utah: Fuel Tanks for Space Plane," *The Salt Lake Tribune* (29 Apr. 1997) http://www.sltrib.com/97/apr/042997/utah/13750.htm (accessed: 10 Mar. 1998); *see also* Statement of R. Christiansen before the U.S. House of Representatives Committee on Science (12 Feb. 1998) http://www.hq.nasa.gov/office/legaff/christiansen2-12.html (accessed: 25 Apr. 1998) [hereinafter Christiansen].

[65] United States, White House Fact Sheet, "National Space Policy" (19 Sept. 1996) [hereinafter "National Space Policy"].

[66] Christiansen, *supra* note 64.

[67] *Id.* Currently, the Future-X program has two segments, the Pathfinder program and the Trailblazer program. *Id.* The Pathfinder-X vehicles would be purely demonstration/experimental vehicles, whereas the Trailblazer vehicles would be prototypes for operational vehicles. *See* NASA Space Transportation Programs Office, "Future-X," http://stp.msfc.nasa.gov/stpweb/futurex/futurexhome.html (accessed: 25 Apr. 1998).

orbit technologies, Future-X demonstrators will flight test technologies for multiple applications including orbital and commercial transport, [a] military spaceplane, human exploration, multi-stage and hypersonics research," and spacelift functions.[68] Thus, an operational Future-X vehicle would be a truly hybrid spaceplane.

i. Other U.S. Air Force Projects

The Air Force has primary responsibility for developing the government's expendable launch vehicle program,[69] but it maintains an interest in acquiring a military spaceplane that could be used, *inter alia*, for launch purposes. Its current spaceplane activity is largely in the concept phase. One of the proposals in the 1994 Air Force study Spacecast 2020 was that the Air Force develop an SSTO, fully reusable, manned transatmospheric vehicle, referred to as Black Horse.[70] To improve feasibility of an SSTO design, the study recommended that the vehicle be designed such that it could be launched with enough fuel to reach a certain altitude, where it would be refueled, by an aircraft such as a modified KC-135 tanker, with enough fuel to enable it to reach orbit.[71] The Black Horse would be able to maneuver in the atmosphere and in outer space, and it would be able to be reused within a matter of hours.[72] The vehicle would take off horizontally from a conventional runway using rocket power, and would land by gliding onto a runway.[73]

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[68] NASA Vehicle Analysis Branch, http://vab02.larc.nasa.gov/Activities/X-37.html (accessed: 25 Apr. 1998).

[69] "National Space Policy," *supra* note 65.

[70] "Space Lift: Suborbital, Earth to Orbit, and on Orbit," *Air Power Journal* (Summer 1995) http://www.cdsar.af.mil/apj/spacast3.html (accessed: 25 Apr. 1998).

[71] *Id.; see also* "In-flight propellant transfer spaceplane design and testing considerations," http://www.islandone.org/Launch/BlackHorse-PropTransfer.html (accessed: 29 Apr. 1998).

[72] W.B. Scott, "Cutbacks Foster Novel Military Space Concepts," *AW&ST* (5 Sept. 1994) 101.

[73] "Aerial Propellant Transfer to Augment the Performance of Spaceplanes," http://www.islandone.org/Launch/BlackHorse.html (accessed: 29 Apr. 1998).

Failing to receive funding in the Fiscal Year 1998 budget for further study of a military spaceplane,[74] the Air Force scaled back its efforts in this area. If funding is secured in the future, it plans to develop a reusable Space Operations Vehicle (military spaceplane) demonstrator to launch its reusable Space Maneuver Vehicle, a 'mini-spaceplane' that could conduct sustained operations in orbit for up to a year.[75]

In late 1997, the Commander of Air Force Space Command, General Howell M. Estes III, opined that "[a] military spaceplane won't evolve 'until we find new, [less expensive,] methods of propulsion.'"[76] Not surprisingly, in February 1998, the Air Force awarded a contract to Pratt and Whitney to design and test a scramjet engine.[77] Scramjet engines are considered to be "key to single-stage to orbit reusable space vehicles that include airbreathers for much of [the] first-stage flight."[78]

The President's Fiscal Year 1999 Budget request does not include funding for a military spaceplane.[79] A White House official pointed out that the President's budget request did not provide for a spaceplane because the Pentagon's 'Future Years Defense Plan' does not discuss such a vehicle, and "this was an indication that [the project is] not a high priority among senior military leadership."[80] However, the U.S. House of

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[74] In September 1997, in anticipation that it would obtain the funding, the Air Force awarded two contracts—one to Lockheed Martin and the other to McDonnell Douglas—to conduct studies leading to proposals for a military spaceplane. "The USAF," *AW&ST* (15 Sept. 1997) 19. The U.S. Congress authorized $10 million in the Fiscal Year 1998 Department of Defense (DoD) Budget, but President Clinton vetoed the military spaceplane line item in October 1997. P. Mann, "Defense Veto Renews Constitutional Issues," *AW&ST* (20 Oct. 1997) 30. The Clinton Administration found that DoD had not expressed a requirement for a military spaceplane, and concluded that a military program was unnecessary because NASA was already working on a civil spaceplane program (the X-33). *Id.*

[75] S. Evers, "USAF to Test Space-based Reconnaissance Vehicle," *Jane's Defence Weekly* (10 Sept. 1997) 11; *see also* W.B. Scott, "Plan Confronts Space Control Issues," *AW&ST* (13 Apr. 1998) 30.

[76] "Estes," *supra* note 63.

[77] "Air Force Awards Scramjet Engine Work to P&W," *Mil. Sp.* (16 Feb. 1998).

[78] *Id.*

[79] "U.S.—Renewed Push for Military Space Research," *Periscope Daily Defense News Capsules* (27 Feb. 1998) [hereinafter "Renewed Push"].

[80] *Id.*

Representatives' version of the Fiscal Year 1999 defense authorization bill did include funds for a "new re-entry space vehicle that 'can deliver payloads anywhere on Earth from a suborbital trajectory within 90 minutes.'"[81] It is possible, therefore, that the Air Force's spaceplane project will be funded in fiscal year 1999.[82]

j. Commercial Efforts

i. Lockheed Martin Corp., which is developing NASA's X-33 spaceplane, plans to use a modified version of the X-33 for its future VentureStar commercial spaceplane.[83] Initially, Lockheed Martin plans to utilize the reusable VentureStar for cargo transport, but might later modify it for astronaut transport.[84]

ii. Space Access is another corporation working on an unmanned commercial RLV.[85] The vehicle would have three stages. The first stage would be an 'aerospacecraft,' an aircraft-like vehicle that would be propelled toward space on a horizontal trajectory via an 'ejector ramjet'/airbreathing propulsion system. A rocket-powered second stage, referred to as the 'reusable spacecraft,' would be released from the aerospacecraft to carry payloads into orbit. A third stage, a smaller reusable 'orbit transfer craft,' could also be released from the aerospacecraft to transport payloads into orbit. Each stage would return to earth by gliding horizontally onto a landing site.[86]

iii. The X-Prize Foundation, a private, non-profit organization, has offered a prize of $10 million to the first private corporation or individual that builds a

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[81] "Early Warning," *Mil. Sp.* (25 May 1998).

[82] A recent U.S. Supreme Court holding that the presidential line-item veto is unconstitutional gives the proposed spaceplane funding a strong chance of becoming official if it otherwise survives the congressional process. *See Clinton v. New York,* No. 97-1374 (U.S. Sup. Ct., 25 June 1998) (available on LEXIS, GENFED library, COURTS file (1998 U.S. Lexis 4215)).

[83] J.C. Anselmo, "Human Cargo," *AW&ST* (4 May 1998) 17.

[84] *Id.*

[85] W.B. Scott, "Space Access' Launch System Based on Airbreathing Ejector Ramjet," *AW&ST* (30 Mar. 1998) 75.

[86] *Id.*

"spacecraft which can carry three people on a suborbital flight to an altitude of 100 km."[87] The goal is "to challenge the best engineers and innovators to build a spacecraft that eventually could be used to develop a commercial space transportation and tourism industry."[88] There were sixteen competitors as of October 1997.

iv. One of the competitors for the X-Prize is Pioneer Rocketplane. They had previously begun designing a "piloted, conventional take-off and landing, but air-refuelled, spaceplane for fast-reaction, same-day, LEO [low earth orbit] satellite deployments."[89] To "broaden initial mission flexibility of . . . [the vehicle, it would also be used for] surface-to-surface package delivery."[90] This vehicle, called Pathfinder, would take off with the assistance of kerosene fuel, but, upon reaching a certain altitude, would be refueled with liquid oxygen by a tanker aircraft. The liquid oxygen would be used by the vehicle's rocket engines to propel it into orbit.[91]

v. Kelly Space and Technology, Inc. (KST), is developing a reusable launcher called Eclipse which it hopes will be operational in 1999.[92] The spaceplane consists of a first-stage aircraft, such as a Boeing 747, that would release a suborbital vehicle upon reaching a certain altitude. The suborbital vehicle would be propelled into orbit by a rocket engine. The vehicle would make a powered return to earth and could

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[87] A. Rendell, "Private Pioneers," *Flight Int'l* (8 Oct. 1997) 44 [hereinafter "Pioneers"].

[88] *Id.*

[89] A. Rendell, "Launcher Proposals," *Flight Int'l* (10 Dec. 1997) 32; *see also* C. Lardier, "Plethore de Projets de Lanceurs exotiques," *Air & Cosmos* (3 Apr. 1998) 40 [hereinafter Lardier]; "McPeak, Hecker," *supra* note 14 (stating that the Pathfinder is derived from the "Black Horse" concept discussed in the U.S. Air Force's Spacecast 2020 study).

[90] "McPeak, Hecker," *supra* note 14.

[91] "Pioneers," *supra* note 87.

[92] Lardier, *supra* note 89, at 40.

land on conventional airport runways. It is reported that Motorola has expressed interest in using the Eclipse for at least ten launches when it becomes operational.[93]

2. Soviet Union/Russian Federation

The Soviet Union started work on reusable spaceplane concepts in the 1950s, but it was not until the 1980s that they began to show success in this area.[94] In August 1987, and on at least four prior occasions, they conducted unmanned test flights of a sub-scale version of a winged military spaceplane.[95] It was believed that the Soviet spaceplane would "become the world's first space fighter, providing the USSR with a quick-reaction capability for space station defense, antisatellite operations, strategic reconnaissance and emergency repair of Soviet satellites."[96] The author has located no information indicating that a full-scale military spaceplane was built.

In 1988, the Soviets launched a full-scale reusable civil space shuttle known as Buran.[97] Buran was tested several times through manned suborbital flights, but its first and only launch into orbit, on 15 November 1988, was unmanned.[98] The largest Soviet expendable launch vehicle, Energia, was used to launch Buran.[99] Although two Buran shuttles were built, the program was cancelled in 1993 with no additional flights having been made.[100] It is believed that economic problems in the Soviet Union in the 1980s

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[93] *Id.; see also supra* note 12 (Motorola's plans for several telecommunications and global personal communication satellite constellations will make it a regular customer of launch services.).

[94] "Space Race," *supra* note 30.

[95] "Pentagon Reviews Data on Soviet Spaceplane Test," *AW&ST* (31 Aug. 1987) 27 [hereinafter "Pentagon Reviews"].

[96] *Id.*

[97] "Space Race," *supra* note 30. *See also* "Pentagon Reviews," *supra* note 95 (asserting that the Buran program was separate from the Soviet military spaceplane program).

[98] "Space Race," *supra* note 30.

[99] *Id.*

[100] *Id.*; *Microsoft Encarta, supra* note 34.

severely hurt the Soviet space program, including the Buran program.[101] It does not appear that the Russian Federation has taken action to reactivate the program.[102]

Other spaceplane projects that were active in the early 1990s, but which appear to have been affected by funding shortfalls, include: a) a Soviet program to develop an SSTO hypersonic spaceplane that could take off from and land on conventional airports and be reused within a short timeframe;[103] b) a Russian program to develop a TSTO aerospace vehicle that would consist of a reusable orbiter to be launched into orbit from an aircraft;[104] and c) a project by rocket engine manufacturer NPO Energomash to develop an engine to boost an air-launched shuttle-like vehicle into orbit.[105]

Nevertheless, hypersonic research continues in Russia, where a scramjet engine has already been developed and tested.[106] Moreover, the Central Institute of Aviation Motors in Moscow is said to be designing an SSTO spaceplane.[107]

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[101] H. Gavaghan, "Soviets Search for Partners in Space," *New Scientist* (2 Nov. 1991) 17. There are those who view the stagnant state of the Soviet space program with disbelief since it was the Soviets who put the first satellite in space and the first man in space. And it's the Soviets who have a permanent manned station in space, and have stationed people in space for longer than any other nation. *Id.*

[102] *See* "New Soyuz Lifeboat Ready to Evacuate Mir Crew," Reuters News Service (21 Aug. 1997) http://204.71.177.72/headlines/970821/international/stories/mir_18.html (accessed: 10 May 1998). The Russian Federation uses its Soyuz spacecraft to transport cosmonauts and supplies to and from space. The Soyuz vehicle can hold up to three persons. Soyuz is a bullet-shaped capsule that floats to earth through the use of a parachute, and usually lands on the steppes of Kazakhstan. *Id.* Soyuz is not discussed in the text of this thesis as a spaceplane because it does not have aircraft-like qualities.

[103] E. DeRitis, J. Endoso, and S. Arenstein, "Gorbachev Forces Public Discussion of Soviet Space Plane Effort," *Soviet Aerospace and Technology* (29 July 1991) 4.

[104] A. Bolonkin, "Russia Looks West," *Aerospace America* (Mar. 1993) 13.

[105] C. Bulloch, "Fools' Gold at the End of the Russian Rainbow?" *Interavia Aerospace World* (Apr. 1994) 59 [hereinafter Bulloch].

[106] I. Sheppard, "Towards Hypersonic Flight," *Flight Int'l* (26 Nov. 1997) 44.

[107] *See* Federation of American Scientists, World Space Guide, "Reusable Launch Vehicles [in Russia]," http://www.fas.org/spp/guide/russia/launch/reusable.html (accessed: 9 June 1998).

3. Germany

In the mid-1980s, West Germany proposed to develop a reusable hypersonic TSTO airbreathing spaceplane that could be used by the European Space Agency (ESA) as a lower-cost alternative to the U.S. Space Shuttle to carry passengers and cargo into low earth orbit.[108] The vehicle, called 'Sänger,' after spaceplane pioneer Eugen Sänger, was originally conceived in the 1970s.[109] The vehicle would have an HTOL configuration, enabling it to use conventional airport runways; and it would have a turnaround time of a few days.[110] If the 'Sänger' was successful, Germany planned to modify it to build a transatmospheric vehicle that could be used for earth-to-earth transportation of passengers and cargo.[111] The earth-to-orbit vehicle would have two stages—the first would be a hypersonic aircraft that would travel to an altitude of about 18 miles, at which point a manned space orbital vehicle (the second stage) would detach from the aircraft and would be launched into orbit by a rocket engine.[112]

Unable alone to afford to fund the development of the vehicle, Germany decided in 1991 to delay the design and test phase of the vehicle in hopes of convincing ESA to fund the development phase of the program.[113] ESA did not adopt the 'Sänger' program, and it appears that the program has been postponed indefinitely.[114]

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[108] "Germans Propose Spaceplane to ESA to Compete with Shuttle, HOTOL," *AW&ST* (28 July 1986) 27 [hereinafter "Germans Propose"].

[109] M. Mecham, "Germany to Delay Saenger [sic] Program While ESA Defines Space Goals," *AW&ST* (22 Apr. 1991) 26 [hereinafter Mecham].

[110] "Germans Propose," *supra* note 108.

[111] *Id.*

[112] *Id.* Stage two was called HORUS (Horizontal Orbital Upper Stage). Rosen, *supra* note 48, at 72.

[113] Mecham, *supra* note 109.

[114] Federation of American Scientists, World Space Guide, "Germany and Piloted Space Missions," http://www.fas.org/spp/guide/germany/piloted/index.html (accessed: 9 June 1998).

Germany is still exploring hypersonic space transportation technology.[115] For example, the German Aerospace Center (DLR—Deutsches Zentrum für Luft- und Raumfahrt) has been working on a TSTO space transportation system called DSL.[116] The first stage of this vehicle would be a supersonic carrier aircraft that could carry either reusable or expendable launchers.[117]

4. Great Britain

In 1984, British Aerospace (BAe) began working on a reusable, unmanned SSTO called HOTOL (horizontal takeoff and landing).[118] HOTOL would take off from a conventional runway using an airbreathing engine that would later shut down so that a rocket engine could be activated to propel the vehicle into orbit.[119] The vehicle would return to earth by gliding horizontally onto a conventional runway, would be available for reuse within 48 hours, and would have a per-launch cost lower than that of other launch vehicles.[120] Only earth-to-orbit missions were envisioned for it.

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[115] Bulloch, *supra* note 105; *see also* Federation of American Scientists, World Space Guide, "Germany and Space Transportation," http://www.fas.org/spp/guide/germany/launch/index.html (accessed: 9 June 1998).

[116] "The DSL Space Transportation System," http://www.kp.dlr.de/DSL/DSL-WWW1.HTML (accessed: 9 June 1998). "*DSL* is the conceptual name of an advanced supersonic staging STS [space transportation system], which dates back to the year 1992. Today the name is without any official meaning, but is still in use for historic reasons." *Id.*

[117] *Id.*

[118] "All Shapes and Sizes—A Long Wait at the Spaceport," *The Economist* (3 Sept. 1988) 26 [hereinafter "All Shapes"]. Note: There have been several British spaceplane concepts presented since the 1950s. *See* Reaction Engines Limited, "The History of British Spaceplane Concepts," http://www.gbnet.net/orgs/skylon/skyhist.htm (accessed: 9 June 1998).

[119] "All Shapes," *supra* note 118.

[120] *Id.*; *see also* Space Knowledge, "Proposed European Space Planes," http://tommy.jsc.nasa.gov/~woodfill/SPACEED/SEHHTML/know20.html (accessed: 8 Feb. 1998) (launches on HOTOL could cost between $4 - 5 million).

The HOTOL program ran into trouble when the British government stopped funding it in 1987.[121] BAe tried to continue the program by adding foreign partners, but in 1992, limited funding and technological difficulties required that they reconfigure the vehicle into an air-launched satellite launcher, thereby foregoing the hybrid engine.[122] This Interim HOTOL program still has not moved beyond the concept phase.

In 1994, work began on the Skylon, an unmanned spaceplane derived from the original HOTOL design. Like HOTOL, Skylon would take off and land horizontally using conventional runways, and it would only conduct earth-to-orbit missions.[123] For takeoff, the vehicle would use specially designed airbreathing power packs that would later turn power over to rockets for entry into orbit.[124] The British company Reaction Engines Ltd is still working on this project, but without the benefit of government funding.[125] The British government is said to believe that the project is "over-optimistic technically and financially."[126] Nevertheless, government interest is reflected in the British Ministry of Defence's statement that it would oppose the export of any new technology developed as a result of the Skylon project.[127]

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[121] B. Fox, "Patent Office Reveals HOTOL's Secrets," *New Scientist* (31 Aug. 1991) 21. The British government was apparently very interested in the program in its early stages, and even classified the program in the light of the potential military uses for the spaceplane. However, the government lost interest in the program, and eventually declassified it. *Id.* It appears that the difficulties encountered in developing the technology needed for the hybrid engine is what led the government to cancel the program. *See* H. Dawley, "A Way to Cool Planes for a Leap Into Space," *Bus. Wk.* (2 Feb. 1998) 65 [hereinafter Dawley].

[122] "Launcher Directory—British Aerospace," *Flight Int'l* (15 Apr. 1992).

[123] "British Design Space Plane," *Machine Design* (4 Apr. 1994) 24.

[124] *Id.*

[125] Lardier, *supra* note 89; *see also* "UK Presses ESA to Consider HOTOL," *Flight Int'l* (24 Aug. 1993) [hereinafter "UK Presses"]; Reaction Engines Limited, "The Skylon Tour—Introduction to the Concept," http://www.gbnet.net/orgs/skylon/tourint1.htm (accessed: 9 June 1998).

[126] "UK Presses," *supra* note 125.

[127] *Id.*

Other spaceplane-related efforts in Great Britain include development of a heat exchanger at Bristol University that could be "used to build air-breathing engines for hypersonic aircraft."[128] The engineers who developed the heat exchanger hope that it will rekindle government interest in and support for the HOTOL.[129]

5. France

The French space agency CNES (Centre National d'Etudes Spatiales/National Center for Space Studies) awarded a contract in 1989 for the design of a manned HTOL spaceplane called STAR-H (systeme de transport spatiale areobie re-utilizable horizontale) to compete against the 'Sänger' and HOTOL spaceplanes.[130] STAR-H would be a TSTO vehicle—an airbreathing engine would take the vehicle up to about 35 km, where a reusable second stage orbiter, powered by an expendable rocket engine, would detach from the vehicle to carry the payloads into orbit.[131] In 1990, the French company Dassault, which was designing STAR-H, sought funding partnerships with American and other European companies to help with the project.[132] The author has not found additional information concerning the status of this project. It is known, however, that France continued to explore hypersonic scramjet technology as part of its PREPHA (Programme de Recherche en Propulsion Hypersonique Avancée) program.[133]

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[128] M. Ward, "Cool Futures," *New Scientist* (7 Feb. 1998) 21 [hereinafter Ward].

[129] Dawley, *supra* note 121, at 65.

[130] "Dassault Designs Sänger Rival," *Flight Int'l* (28 Oct. 1989).

[131] *Id.*; *see also* S. W. Kandebo, "Spaceplane Conference Highlights International Hypersonic Programs," *AW&ST* (12 Nov. 1990) 66; "French Advanced Launcher Concept Employs Reusable First Stage, Orbiter," *AW&ST* (13 Nov. 1989) 33.

[132] "Heat is on Hermes," *Flight Int'l* (7 Nov. 1990) [hereinafter "Heat"].

[133] Bulloch, *supra* note 105.

6. *The European Space Agency*

In 1987, ESA selected a French proposal--Hermes--for its future space transportation vehicle. It was hoped that Hermes would "ensure autonomous European manned space operations early in the 21st century."[134] Initiated by CNES in the mid-1970s, the Hermes spaceplane was to be a small, manned, reusable space shuttle.[135] It would have been launched by a French Ariane 5 booster, and would have returned to earth in an unpowered glide.[136] Twelve states contributed funding for the program—France, Germany, and Italy were the largest shareholders.[137] The program was cancelled in 1993 due to a lack of sufficient funds to cover its escalating costs.[138] An attempt to keep the program alive by adding Russia as a partner failed.[139]

ESA continues to explore the feasibility of hypersonic reusable launch technology through its FESTIP (Future European Space Transportation Investigation Program) program.[140] ESA recognizes that "[p]ressure from competition, particularly in the launcher field with new providers such as Russia, Japan and China in the market, will lead to a large effort directed at a significant reduction in launch costs via the improvement of existing systems and/or the introduction of reusable launch

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[134] "Heat," *supra* note 132.

[135] van Traa-Engelman, *supra* note 9.

[136] S.W. Kandebo, "Japanese Outline Spaceplane Program at International Forum," *AW&ST* (10 Oct. 1988) 38; W.J.D. Escher, "A Winning Combination for Tomorrow's Spaceliners," *Aerospace America* (Feb. 1996) 38 [hereinafter Escher].

[137] "Heat," *supra* note 132. Belgium, Spain, the Netherlands, Switzerland, Sweden, Austria, Denmark, Norway, and Canada contributed smaller amounts. *Id.*

[138] "Space Programs—National," *Grolier Multimedia Encyclopedia,* CD-ROM (Danbury, CT: Grolier, Inc., 1996).

[139] European Space Agency Publication, Brochure 114, "The Manned Space and Microgravity Programmes," http://esapub.esrin.esa.it/br/br114/br114man.htm (accessed: 9 June 1998).

[140] J. Grey, "Airbreathing Propulsion for Aerospace Transport," *Aerospace America* (July 1997) 3; C. Lardier, "L'Europe Spatiale se projette jusqu'en 2050," *Air & Cosmos* (19 Jan. 1996) 24.

vehicles."[141] Unfortunately, due in large part to an apparent lack of strong political support, it is believed that, for the foreseeable future, ESA's advanced launch technology program will not include a manned reusable spaceplane.[142]

7. Japan

Japan announced its plans to launch a two-phased spaceplane development program in 1986. First, the National Space Development Agency (NASDA) would develop a small, unmanned spaceplane called HOPE (H-2 orbiting plane) that would be launched vertically by a Japanese H-2 booster, and would return to earth unpowered.[143] HOPE was cancelled in mid-1997 due to budget cuts.[144] The second phase of the Japanese initiative was to be the development of a large, manned, hybrid airbreathing/ rocket-engine HTOL spaceplane, but this program never materialized.[145]

In addition to the NASDA efforts, two other Japanese agencies conducted spaceplane studies in the 1980s and early 1990s. The National Aerospace Laboratory (NAL)--considered a leading center for spaceplane research--has studied at least three engine options for spaceplanes, including an SSTO concept; and the Institute of Space and Astronautical Science--part of the Department of Education--has conducted research into a Highly Maneuverable Experimental Space Vehicle (HIMES).[146] No operational vehicles resulted from these studies. Nevertheless, despite the setbacks to the national spaceplane program, Japan's Space and Technology Agency recently

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[141] European Space Agency Publication, SP 1187, "2000 - 2050: Pragmatism and Adventure," http://esapub.esrin.esa.it/sp/sp1187/pragmati.htm (accessed: 9 June 1998).

[142] C. Lardier, "Les Vols habites entrent dans le XXI[e] Siecle," *Air & Cosmos* (3 Apr. 1998) 27; *see also Reaching for the Skies*, *supra* note 6.

[143] Escher, *supra* note 136.

[144] A. Chuter, "Japanese Abandon HOPE Spaceplane Project," *Flight Int'l* (6 Aug. 1997) 24 [hereinafter Chuter].

[145] "Japanese Panel Recommends Spaceplane Development," *AW&ST* (6 July 1987) 31; Chuter, *supra* note 144.

[146] "Japan's High Frontier," *Flight Int'l* (2 May 1990); *see also* GAO/NSIAD-92-5, *supra* note 2.

suggested that the HOPE be replaced by a reusable, unmanned SSTO spaceplane.[147] In the meantime, the Japanese corporation ATREX is in the process of developing SSTO and TSTO spaceplanes.

8. India

India recently began research into an unmanned SSTO vehicle "that could be used to launch intelligence and surveillance satellites," called Avatar (Aerobic Vehicle for Advanced Trans-Atmospheric Research).[148] This vehicle would take off like a conventional aircraft and would be powered by a ramjet engine. At cruise altitude, a scramjet engine would accelerate it to Mach 7; then a rocket engine would propel it into orbit. The spacecraft would land under its own power.[149]

C. Chapter Summary

With the exception of the U.S. Space Shuttle Orbiter, budget constraints and difficulties developing the advanced technology necessary to enable spaceplanes to work in the atmosphere and in space at hypersonic speeds in a cost-effective manner have prevented these instrumentalities from moving beyond the experimental phase.[150] However, if the demonstration flights of NASA's X-33 are successful, production of full-scale operational models of it will undoubtedly be followed by spaceplane development by governmental agencies and/or private corporations of major aerospace nations. The advent of operational spaceplanes will, in turn, be accompanied by several legal issues dealt with in the chapters that follow.

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[147] Chuter, *supra* note 144.

[148] J.C. Anselmo, "India's SSTO," *AW&ST* (29 June 1998) 17.

[149] *Id.*

[150] Ward, *supra* note 128.

CHAPTER II

The Lack of a Boundary Between Airspace and Outer Space, Part I: Existing Legal Regimes

As is natural, the international community has developed laws to govern their interactions and to set out the collective and individual rights of states in airspace and outer space. The existence of separate air and space legal regimes indicates that there is a legal distinction between airspace and outer space--one that remains unsettled to this day. None of the international air laws or space laws define the terms 'airspace' and 'outer space.' Despite the uncertainty of their scope, these regimes have coexisted harmoniously for decades. Several jurists have predicted, however, that the hybrid nature of spaceplanes will disrupt that harmony and force states to resolve the issues raised by the lack of a boundary between airspace and outer space.

A. Air Law and the Principle of State Sovereignty

International agreement regarding airspace was first embodied in treaty form in the 1919 Paris Convention for the Regulation of Aerial Navigation.[151] World War I showed states that aircraft would grow in importance not only as a wartime weapon, but as a useful civilian vehicle as well. It was for this latter reason that states thought it important to agree on the conduct of peacetime international aerial navigation.[152]

Choosing to avoid international regulation of military use of airspace--no doubt to avoid raising political sensitivities--states nevertheless wanted to assert their sovereign rights over their superjacent airspace. Article 1 of the 1919 Paris Convention proclaimed that "[e]very Power has complete and exclusive sovereignty over the air

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[151] 11 L.N.T.S. 173, 226 C.T.S. 246 (13 Oct. 1919) [hereinafter 1919 Paris Convention].

[152] N.M. Matte, *Treatise on Air-Aeronautical Law* (Toronto: The Carswell Co. Ltd., 1981) 98 [hereinafter *Air-Aeronautical Law*].

space above its territory."[153] This sovereignty principle applied to all states, regardless of whether they were signatories to the Convention. The Convention did not define 'airspace,' most likely because at the time the treaty was drafted, states considered that their "geographical boundaries . . . extended upwards, *usque ad coelum*."[154]

Article 2 of the Convention granted a right of innocent passage for civil aircraft through foreign airspace. This right was limited in several ways: it only applied to contracting states and adherents to the Convention; and the overflown states had the right to prohibit flight over certain areas of their territory, to restrict the aircraft to certain routes, and to require foreign aircraft to land for security reasons.[155] It is said that even though this right of innocent passage existed, in practice, states required that foreign aircraft obtain prior consent to enter their airspace.[156] The 1919 Paris Convention required state aircraft to "obtain special authorization in order to fly from one Contracting State to another or to land in a foreign Contracting State," but military aircraft were granted "privileges . . .customarily accorded to foreign ships of war."[157]

In 1944, the 1919 Paris Convention was superseded by the Chicago Convention on International Civil Aviation,[158] which is still in force. Like its predecessor, the Chicago Convention was spurred by the events of a major war, World War II. Once again, the military uses of aircraft as weapons caused most states present at Chicago to want to strengthen international agreement regarding sovereignty and control over superjacent airspace.[159] A minority, led by the United States, hoped to lessen the

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[153] 1919 Paris Convention, *supra* note 151.

[154] *Air-Aeronautical Law, supra* note 152, at 103.

[155] *Id.* at 106, 107.

[156] American Bar Foundation, *supra* note 24, at 37.

[157] *Air-Aeronautical Law, supra* note 152, at 108, 109.

[158] 15 U.N.T.S. 295, 61 Stat. 1180, T.I.A.S. No. 1591 (7 Dec. 1944) [hereinafter Chicago Convention].

[159] *Air-Aeronautical Law, supra* note 152, at 129.

restrictions on civil air navigation.[160] The U.S. advocated an 'open skies' approach whereby there would be "complete freedom of the air for international commerce for the use of mankind."[161] The majority of the Chicago Convention conferees rejected the American position.[162] Repeating almost verbatim Article 1 of the Paris Convention, the first Article of the Chicago Convention proclaims: "[t]he contracting States recognize that every State has complete and exclusive sovereignty over the airspace above its territory."[163] The sovereign right over national airspace applies to all States, regardless of whether they are parties to the Convention.

Unlike the Paris Convention, the Chicago Convention does not allow innocent passage, and it excludes state aircraft, including military aircraft, from its provisions. But like its predecessor, the Chicago Convention does not define 'airspace.'

1. What is meant by state sovereignty over airspace?

In essence, sovereignty over the airspace above the territory of a state means that that state has the authority to exercise jurisdiction over the activities which take

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[160] *Id.* at 126. The United States never ratified the 1919 Paris Convention.

[161] *Id.* at 128.

[162] Instead of inclusion in the Chicago Convention, the U.S.'s proposed "freedoms of the air" were included in two additional agreements that were drafted during the same 1944 Chicago conference—the International Air Services Transit Agreement (the "two freedoms" agreement) and the International Air Transport Agreement (the "five freedoms" agreement). These agreements, which are in force, are reprinted in XVIII-II *Ann. Air & Sp. L.* (1993). The first of the freedoms, the privilege of the scheduled aircraft of one state to fly across another state's territory without landing, amounts to innocent passage. Dr. Goedhuis points out, however, that despite the relatively large number of states that became parties to the Transit Agreement, this privilege "cannot as yet be considered as a rule of customary international law. There are still several countries, which from the point of view of such passage, are of great importance but which have not yet accepted the agreement." D. Goedhuis, "The Problems of the Frontiers of Outer Space and Air Space," 174 *Recueil des Cours: Collected Courses of the Hague Academy of International Law* 371, 379 (The Hague: Martinus Nijhoff, 1982) [hereinafter *Recueil des Cours*]. For example, the Russian Federation has not signed the Agreement, and Canada withdrew from it. Both of these states have very large territories, passage through which would provide other states shorter flight paths to certain third states. The absence of Russia and Canada as parties illustrates the point that a particular practice cannot be considered to have become customary international law unless, *inter alia*, states "whose interests are specially affected" subscribe to the practice. *I.C.J. Rep.* 3, 43 (1969) (the *North Sea Continental Shelf Cases*).

[163] Chicago Convention, Article 1, *supra* note 158.

place in that airspace. That is, the state decides what activities can occur there and who can conduct them. The Chicago Convention provides that states have the authority to require foreign scheduled aircraft to obtain prior authorization for entering their airspace (Article 6). Non-scheduled aircraft can enter foreign airspace subject to the right of the overflown state to restrict the flight to certain routes or to require the aircraft to land (Article 5). Article 8 requires that pilotless aircraft receive prior authorization to enter foreign airspace. Although the Chicago Convention expressly applies only to civil aircraft, the principle of state sovereignty over superjacent airspace is considered so basic that military aircraft, and probably spacecraft, also must have prior authorization to enter foreign airspace.[164]

There are two major reasons why states want to exercise jurisdiction and control in their superjacent airspace--security and economic considerations.[165] Also, states rarely allow access to their airspace without some sort of *quid pro quo*.[166]

2. What happens when sovereignty is violated?

There are several well-known cases that make it clear states do not take unauthorized flights of aircraft into their airspace (aerial intrusions) lightly. As regards military aircraft, there was the case of the Soviet shootdown of an American U-2 spy plane over Soviet airspace in 1960. The U.S. never claimed that the U-2 was authorized to be over the Soviet territory, nor did it ever claim that the Soviets had no authority to shoot the plane down. It, therefore, appears that the U.S. accepts the

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[164] C.W. Jenks, *Space Law* (London: Stevens & Sons, 1965) 232 [hereinafter Jenks] (re spacecraft); F. Fedele, *Peacetime Reconnaissance From Air Space and Outer Space: A Study of Defensive Rights in Contemporary International Law* (LL.M. Thesis, McGill University Institute of Air and Space Law, Montreal, 1965) 80 [unpublished] (re military aircraft).

[165] American Bar Foundation, *supra* note 24, at 38. *See also* J.E.S. Fawcett, *International Law and the Uses of Outer Space* (Manchester, G.B.: Manchester Univ. Press, 1968) 23 [hereinafter Fawcett] (two other reasons are "the prevention of nuisance [and] the maintenance of good order").

[166] American Bar Foundation, *supra* note 24, at 38 (saying states are "unremitting" in their demands for *quid pro quo*).

notion that states may use force against intruding military aircraft when their hostile intent is obvious.[167]

States have also shot down intruding civil aircraft. In 1973, the Israelis shot down a Libyan airliner that was flying, unauthorized, over the Israeli-occupied territory of Sinai. Once the pilots realized they were off course, they failed to respond to Israel's signals, and ignored the requests to land.[168] Another example is that of the Soviet shootdown of Korean Airlines (KAL) Flight 007 in 1983. That aircraft was flying for two hours, although unknowingly, through Soviet airspace. The Soviet fighter aircraft either failed to signal to the Korean plane or its signals were not seen or heard before deadly force was used against KAL 007.[169]

The Chicago Convention currently contains no provisions directly addressing the issue of aerial intrusions. Opponents of using deadly force against civil aircraft argue that Article 9 of the Chicago Convention "contemplates that the remedial measure for aircraft entering a prohibited area is a requirement to [request the aircraft to] land within the territory of the state in which the prohibited area is located."[170] Also, an intruding aircraft may have entered foreign airspace in distress, for which Article 25 of the Convention says states should offer assistance, not shoot down.

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[167] J.T. Phelps, "Contemporary International Legal Issues—Aerial Intrusions by Civil and Military Aircraft in Time of Peace, 107 *Mil. L. Rev.* 255, at 287 (Winter 1985) [hereinafter Phelps]; *see also* B. Cheng, "Outer Space: The International Legal Framework—The International Legal Status of Outer Space, Space Objects, and Spacemen," *Studies in International Space Law* (New York: Oxford Univ. Press, 1997) 383, 389 [hereinafter Cheng]; N.M. Matte, "The Open Skies Initiative: Sovereignty and Legal Implications," IV *Arms Control and Disarmament in Outer Space: Towards a New Order of Survival*, N.M. Matte, ed. (Montreal: Centre for Research in Air and Space Law, McGill Univ., 1991) 123, 156 ("[A] State does not have the right to use armed force against intruding military aircraft except where there has been prior warning and refusal to comply, or where the intruding aircraft demonstrates manifestly hostile intentions. . . in which case self-defense measures would be justified.") [hereinafter Matte].

[168] Phelps, *supra* note 167, at 288.

[169] *Id.* at 260.

[170] Statement of Federal Aviation Administration Administrator Helms Before the ICAO Council, Montreal, 15 Sept. 1983, *excerpted in Public International Air Law Course Materials*, M. Milde, ed. (Montreal: McGill Univ., 1997) 371.

In direct response to the KAL 007 incident, in May 1984, a protocol to amend the Chicago Convention was adopted. This amendment says that "states must refrain from resorting to the use of weapons against civil aircraft in flight and that, in case of interception, the lives of persons on board and the safety of aircraft must not be endangered."[171] The amendment has not yet entered into force.

Thus, while intruding military aircraft are subject to the use of deadly force by the subjacent state when their hostile intent is clear, the rights of subjacent states as regards intruding civil aircraft are not as clear. What is certain is that intruding civil aircraft can be required to land, and that intruding civil aircraft in distress are to be granted the privilege of 'innocent passage.' However, states are not prohibited in all circumstances from using deadly force against intruding civil aircraft. And, even if Article 3 *bis* enters into force, it would not prohibit states from using force against military and other state aircraft, because the Chicago Convention only applies to civil, non-state, aircraft.

B. Space Law and the Principle of Freedom of Outer Space

When they were developing the air law regime, states seemed perfectly content with their assumption that their superjacent airspace rose *ad infinitum*. However, once they began developing the space law regime, states quickly realized there was indeed an upper limit to their national airspace, and, therefore, a limit on their sovereignty in the space above their territories. One of the first indirect international acknowledgments of this limit was in United Nations General Assembly Resolution 1721 (XVI) of December 1961.[172] This resolution announced that "[o]uter space and celestial bodies are free for exploration and use by all States in conformity with international law and

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[171] Protocol Relating to an Amendment to the Convention on International Civil Aviation, Article 3 *bis* (10 May 1984) *reprinted in* XVIII-II *Ann. Air & Sp. L.* 157 (1993).

[172] U.N.G.A. Res., International Co-operation in the Peaceful Uses of Outer Space (3 Jan. 1962) U.N. Doc. A/Res/1721 (XVI) [hereinafter U.N.G.A. Res. 1721].

are not subject to national appropriation."[173] These principles of freedom and non-appropriation were elaborated in the trailblazing U.N. General Assembly Resolution 1962 (XVIII) of December 1963.[174] The authority of this resolution is reflected both in its unanimous adoption,[175] and in the wording of its title—"Declaration of *Legal* Principles Governing the Activities of States in the Exploration and Use of Outer Space" (emphasis added). In that Declaration, states proclaimed, *inter alia*,

> 2. Outer space and celestial bodies are free for exploration and use by all States on a basis of equality and in accordance with international law.
>
> 3. Outer space and celestial bodies are not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means. . . .[176]

Despite its authority, the Declaration was only a resolution, so it did not have the force of law. Consequently, states decided to embody its principles in a treaty.[177] This led to the 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, known as the Outer Space Treaty.[178] The Outer Space Treaty is currently in force. Article I contains the fundamental principle of international space law:

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[173] *Id.* at para. A.1.b.

[174] U.N.G.A. Res., Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space (24 Dec. 1963) U.N. Doc. A/Res/1962 (XVIII), [hereinafter Declaration].

[175] Fawcett, *supra* note 165, at 7.

[176] Declaration, *supra* note 174.

[177] Fawcett, *supra* note 165, at 8-9, 12. Some jurists, such as Professor Goedhuis, assert that the principles of freedom and non-appropriation need not have been embodied in a treaty. He has stated:

> On the basis of the conduct of the overwhelming majority of States, of their acquiescence of such conduct and their express statements, the conclusion can be drawn that there exists a general consensus that the said principles are rules of positive international law, valid independently of any treaty.

D. Goedhuis, "Reflections on Some of the Main Problems Arising in the Future Development of Space Law," XXXVI *Netherl. Int'l L. Rev.* 247, 253 (1989) [hereinafter Goedhuis].

[178] 610 U.N.T.S. 205, 18 U.S.T 2410, T.I.A.S. 6347 (27 Jan. 1967) [hereinafter Outer Space Treaty].

> . . . Outer space, including the moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies.[179]

Article II of the Outer Space Treaty uses language substantially similar to that of Principle 2 of the 1963 Declaration: "Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means."[180]

Thus, states agreed in no uncertain terms that at some point beyond their territorial airspace, they could no longer exercise sovereignty and control. Unfortunately, the Outer Space Treaty, like the 1963 Declaration and other General Assembly outer space resolutions, does not define 'outer space.' Consequently, from a legal standpoint, it is unclear just where the state's authority (*i.e.*, its national airspace) ends and free outer space begins.[181] The space law documents also do not address the issue of whether states have a right of innocent passage through foreign airspace for their spacecraft and other space objects. Finally, it is important to note that the 1967 Outer Space Treaty applies to all space activities--state (including military) and civilian.

1. What does it mean to say that outer space is 'free?'

In essence, to say that outer space is free and not subject to claims of sovereignty or national appropriation means that states cannot place restrictions on the space activities of other states, other than the restrictions agreed upon in space law

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[179] *Id.* at Article I.

[180] *Id.* at Article II.

[181] It has been argued that space law documents do describe outer space. Professor Fawcett, for example, stated:

> [d]escriptions of outer space vary. Sometimes it comprises the orbital paths of earth satellites and beyond [as stated in U.N.G.A. Res 1721B-XVI, para 1]; or it is considered as lying beyond the atmosphere of the earth [as stated in the Nuclear Test Ban Treaty, Article I]; or it may be referred to as including [as stated in the Outer Space Treaty of 1967, Article I], or as being distinct from, the celestial bodies [as stated in U.N.G.A. Resolutions 1721A-XVI, para I(b) and 1962-XVIII, para 2].

Fawcett, *supra* note 165, at 2.

treaties, in the U.N. Charter, and in general principles of international law. For example, states cannot restrict another state's right to self-defense, which is guaranteed by Article 51 of the U.N. Charter; nor may states place nuclear weapons in orbit in outer space or on celestial bodies, as prohibited by Article IV of the Outer Space Treaty and most likely by customary international law.

Hence, regarding space objects orbiting above their territory, subjacent states cannot, as with foreign aircraft in their airspace, force foreign spacecraft to land in their territory for inspection; they cannot specify the orbital path of foreign space objects as they move over the subjacent state's territory; and they cannot use unlawful force against[182] (*e.g.*, shoot down) non-hostile space objects of other states.

2. Why is the 'innocent passage' issue important in the space law regime?

It is axiomatic that spacecraft must pass through airspace en route to and from outer space. Outer space is free for the exploration and use of all, which raises the question of whether space objects can freely use foreign airspace en route to or from free outer space. To date, as far as is known, space objects have not had to traverse the airspace of foreign states en route to outer space. Currently, objects are launched vertically, either from launch sites in states with large territories or from launch sites on or near the high seas, substantially decreasing the possibility that a foreign state's national airspace will be crossed.[183] Additionally, returning objects typically land on either the high seas or at designated locations in launching states with large territories, usually without traversing foreign airspace.[184]

However, while the man-made objects are in orbit, they necessarily pass over the territory of each state beneath their orbital paths. To date, no state has filed a

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[182] *See, e.g., id.* at 6, 7 (asserting that a principle underlying the space law documents is that states cannot use unlawful force in outer space).

[183] N.C. Goldman, *American Space Law: International and Domestic* (San Diego, CA: Univelt, 1996) 106 [hereinafter Goldman].

[184] *See* American Bar Foundation, *supra* note 24, at 67; *see also* Goldman, *supra* note 183, at 106.

formal objection to the orbiting of objects above their territory.[185] This lack of protest has led some to conclude that a customary rule of international law has developed that allows a state to send its space objects through the airspace of other states; that is, that there is now a customary right of innocent passage.[186] An illustration of this belief is a 1979 proposal the Soviet Union submitted to the Legal Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) titled "Approach to the solution of the problems of the delimitation of air space and outer space."[187] The third paragraph of the proposal stated:

> Space objects of States shall *retain* the right to fly over the territory of other States at altitudes lower than 100 (110) km above sea level for the purpose of reaching orbit or returning to earth in the territory of the launching State.[188]

The use of the word 'retain' in this statement implies a pre-existing 'right' to overfly another state's territory—i.e., a right to innocent passage. The Soviets revised their proposal in 1983, recommending that states enter into an agreement establishing a boundary between airspace and outer space, and expressly stating their belief that a right to innocent passage for space objects exists:

> This instrument shall also specify that a space object of any State shall retain the right of innocent (peaceful) passage over the territory of other States at altitudes lower than the agreed boundary for the purpose of reaching orbit or returning to earth.[189]

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[185] American Bar Foundation, *supra* note 24, at 67. Some states raised informal objections to remote sensing and surveillance satellites, but it is now generally accepted that these activities are permissible.

[186] *See, e.g.*, S. Gorove, "Legal and Policy Issues Raised by the Proposed Notion of 'Aerospace Object,'" *Proceedings of the Fortieth Colloquium on the Law of Outer Space* (Reston, VA: 1998) 411, 416 [hereinafter "Legal and Policy Issues"]; C.Q. Christol, *Space Law: Past, Present, and Future* (Boston: Kluwer, 1991) 339 [hereinafter *Space Law*]; M. Lachs, *The Law of Outer Space* (The Netherlands: A.W. Sijthoff, 1972) 59-61 [hereinafter Lachs]; Fawcett, *supra* note 165, at 21; *see also Introduction to Space Law, supra* note 10, at 12.

[187] U.N. COPUOS Legal Subcomm., Working Paper of the USSR, "Draft Basic Provisions of the General Assembly Resolution on the Delimitation of Air Space and Outer Space and on the Legal Status of the Geostationary Satellites' Orbital Space," U.N. Doc. A/AC.105/L.112, 20 June 1979.

[188] *Id.* (emphasis added).

COPUOS members have not yet issued a decision on the Soviet boundary proposal, nor have they formally addressed the 'innocent passage' component of the proposal.[190]

It should be noted that there have been some rare occasions where space objects have crossed foreign territory. For example, in 1978, pieces of the disintegrating, deorbiting Soviet satellite Cosmos 954 fell onto uninhabited parts of northern Canada. In its claim for damages incurred as a result of cleaning up the impact sites, the Canadian government characterized the cause of this damage in part as "the *intrusion* into Canadian air space of a Soviet space object."[191] The claim also commented on the Soviet's failure to notify Canada of Cosmos 954's impending reentry.[192] In a section titled "General Principles of International Law," Canada asserted that

> The *intrusion* of the Cosmos 954 satellite into Canada's air space and the deposit on Canadian territory of hazardous radioactive debris from the satellite *constitutes a violation of Canada's sovereignty*. This violation is established by the mere fact of the trespass of the satellite, the harmful consequences of this intrusion, being the damage caused to Canada by the presence of hazardous radioactive debris and the interference with the sovereign right of Canada to determine the acts that will be performed on its territory. International precedents recognize that a violation of sovereignty gives rise to an obligation to pay compensation.[193]

In its reply to the Canadian claim, the Soviet Union referred to the incident as an "unintentional emergency landing,"[194] perhaps in an attempt to invoke the

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[189] U.N. COPUOS Legal Subcomm., Working Paper of the USSR, "Approach to the Delimitation of Air Space and Outer Space," U.N. Doc. A/AC.105/C.2/L.139, 4 Apr. 1983 [hereinafter U.N. Doc. A/AC.105/C.2/L.139].

[190] *See* I.A. Vlasic, "The Nineties: Problems and Prospects," XVII-I *Ann. Air & Sp. L.* 35, 37 (1992) [hereinafter Vlasic].

[191] Canada, Statement of Claim, 23 Jan. 1979, para. 1, *excerpted in Space Law and Institutions: Documents and Materials*, I.A. Vlasic, ed. (Montreal: McGill Univ. 1997) 295, 295 (emphasis added) (the term 'intrusion' was used several other times throughout the Statement of Claim).

[192] *Id.* at paras. 4, 6.

[193] *Id.* at 299, para. 21 (emphasis added).

exceptions that are usually allowed for vehicles in distress. They settled the claim in 1981.

Another example of a returning space object that landed on foreign territory is that of the U.S. Skylab. After starting to decay prematurely in 1978, the Skylab began to deorbit in 1979, and the U.S. was unable to control its reentry into earth's atmosphere.[195] The spacecraft broke up upon descent and most of the pieces disintegrated during reentry. However, some large pieces landed in the Pacific Ocean and in southwestern Australia. There is no indication that Australia complained that these space object fragments violated its airspace or its territorial sovereignty. The U.S. did provide notice to the Australian government when it appeared that fragments would land on or near Australian territory,[196] but there is no indication that the issues of innocent passage or airspace sovereignty were discussed.

The Cosmos 954 and Skylab incidents concerned space debris that crossed foreign airspace and landed in foreign territory. A third incident is that of a 1990 flight of the returning U.S. Space Shuttle Atlantis over Soviet territory.[197] As a matter of courtesy, the U.S. notified the USSR that the shuttle would soon cross Soviet territory. The U.S. had not requested nor received prior authorization from the Soviet Union for this crossing. Nevertheless, there is no indication that the Soviets voiced objection to the crossing or otherwise complained that it was unlawful. Moreover, the Soviets did

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[194] *See* B. Schwartz and M.L. Berlin, "After the Fall: An Analysis of Canadian Legal Claims for Damage Caused by COSMOS 954," *excerpted in Space Law and Institutions: Documents and Materials*, I.A. Vlasic, ed. (Montreal: McGill Univ. 1997) 301, 303.

[195] *See* Sweeney, Oliver & Leech, "Reentry of Orbiting Space Objects," *excerpted in Space Law and Institutions: Documents and Materials*, I.A. Vlasic, ed. (Montreal: McGill Univ. 1997) 285.

[196] *Id.* at 288.

[197] *See* U.N. COPUOS, Questionnaire on Possible Legal Issues With Regard to Aerospace Objects: Replies From States, U.N. Doc. A/AC.105/635, 15 Feb. 1996, Question 7 (response of the Russian Federation) [hereinafter U.N. Doc. A/AC.105/635]; *see also* "Legal and Policy Issues," *supra* note 186 and accompanying text.

not warn the U.S. against future such crossings. However, both states agreed that this incident would not constitute a precedent.[198]

The U.S. government has not said that a right of innocent passage exists for space objects, however, in 1962, the NASA General Counsel said:

> The area within which the underlying State possesses the right to 'veto' the activity of another State must not be permitted to extend to altitudes which would hamper the freedom of space exploration. It is of little value to speak of the freedom of outer space if man cannot travel freely to that realm and freely back to earth.[199]

Nevertheless, it is generally agreed that a customary right of innocent passage for spacecraft does not exist.[200] The elements that lead to the development of customary international law are not present in the practice of launching and returning space objects. In particular, the relatively small number of states that have launched objects is not considered sufficient to satisfy the 'practice of states' requirement. Secondly, there is no evidence that the overflown states believe that they have a legal obligation to

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[198] U.N. Doc. A/AC.105/635, *supra* note 197, at Question 7 (response of the Russian Federation). Note: the Soviet shuttle Buran is also believed to have traversed foreign airspace, without prior authorization, during its sole flight. No states whose territories may have been crossed are known to have voiced objections to the Buran flight.

[199] *Space Law, supra* note 186, at 331.

[200] *See, e.g.*, T.L. Masson-Zwaan, "The Aerospace Plane: An Object at the Cross-roads Between Air and Space Law," *Air and Space Law: De Lege Ferenda*, T.L. Masson-Zwaan and P.M.J. Mendes de Leon, eds. (The Netherlands: Kluwer, 1992) 247, 253 [hereinafter Masson-Zwaan]; H.A. Wassenbergh, *Principles of Outer Space Law in Hindsight* (The Netherlands: Kluwer, 1991) 36 [hereinafter Wassenbergh]; Goedhuis, *supra* note 177, at 256; American Bar Foundation, *supra* note 24, at 49; Fawcett, *supra* note 165, at 11. In 1978, recognizing that there was no right of innocent passage in customary international law, the International Law Association expressed its support for

> establishing a rule of freedom of passage for spacecraft through the air space of other states for the purpose of putting them into orbit or for returning them to earth, [and welcomed] the growing support for the establishment of such a rule, being aware that the final formulation of this rule should take into consideration the political and economic implications involved both for states active in the exploration and use of outer space and for all other states concerned. . ..

International Law Association, Space Law Resolution, *Report of the 58th Conference of the International Law Association*, Manila, Sept. 1978, *excerpted in Space Law and Institutions: Documents and Materials*, I.A. Vlasic, ed. (Montreal: McGill Univ., 1997) 153.

allow the passage of foreign space objects over their territories; that is, the *opinio juris* element is missing. Thirdly, it does not appear that states that have rejected the privilege of innocent passage for scheduled foreign aircraft flights are willing to apply the principle to spacecraft. This third point illustrates the opinion of the International Court of Justice in the *North Sea Continental Shelf Cases* that a particular practice cannot be considered to have become customary international law unless, *inter alia*, states "whose interests are specially affected" subscribe to the practice.[201] An 'interest' that would be 'specially affected' by transiting spacecraft is the overflown states' interest in exercising sovereign rights over their national airspace.

Professor Goedhuis analogized the idea of innocent passage for space objects to and from outer space to the transit rights of aircraft to and from the high seas.[202] He pointed out that although states have accepted the notion that the airspace over the high seas is free for use by all states, they have not adopted a right of innocent passage for foreign aircraft through territorial airspace en route to and from the high seas. Consequently, he argued that it is unlikely that states have established a customary right of innocent passage for foreign space objects simply because outer space is free for use.

In 1986, while emphasizing that no right of innocent passage exists for spacecraft, the International Civil Aviation Organization (ICAO) Observer to UN COPUOS suggested that such a right is emerging:

> The right of innocent passage of spacecraft through the sovereign airspace is a proposal *de lege ferenda* (*i.e.*, a legislative proposal not reflecting the existing law); and such right does *not* exist under the present international law of the air; an unconditional right of passage through the sovereign airspace does *not* exist even with respect to civil aircraft and is specifically subject to a special authorization with respect to State aircraft and pilotless aircraft.[203]

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[201] *I.C.J. Rep.* 3, 43 (1969).

[202] Goedhuis, *supra* note 177, at 256.

[203] ICAO Doc. C-WP/8158, "Draft Brief for the ICAO Observer to the Legal Sub-Committee of the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS)" (15 Jan. 1986) (emphasis added) [hereinafter ICAO Doc. C-WP/8158].

C. Other Air and Space Law Differences That the Advent of Spaceplanes Might Highlight

In addition to the respective sovereignty versus freedom and non-appropriation principles of air law and space law, there are some other differences that should be mentioned. First, it must be noted that the individual air law instruments focus primarily on either public or private activities, whereas space law instruments encompass both public and private activities. For example, recall that whereas the 1944 Chicago Convention[204] applies only to civil, non-state aviation activities, the 1967 Outer Space Treaty[205] applies to governmental and non-governmental space activities.

A related distinction is that the air law regime provides for the direct pursuit of claims by private persons, while the space law regime does not. Under air law, individuals can submit claims directly against airlines in accordance with the 1929 Warsaw Convention[206] (or the Warsaw Convention as amended by the Hague Protocol[207]). The Warsaw Convention applies to carriage by states unless the state has opted out of such coverage. The 1952 Rome Convention[208] authorizes private parties to make claims against aircraft operators for damage caused by foreign aircraft in flight to persons or property on the surface of the earth. The 1952 Rome Convention does not apply to damage caused by military, customs or police aircraft. Under space law, the Outer Space Treaty makes states responsible for the space activities of state and

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[204] Chicago Convention, *supra* note 158.

[205] Outer Space Treaty, *supra* note 178.

[206] Convention for the Unification of Certain Rules Relating to International Carriage By Air, 137 L.N.T.S. 11, 49 Stat. 3000, T.S. No. 876 (12 Oct. 1929), *reprinted in* XVIII-II *Ann. Air & Sp. L.* 323 (1993) [hereinafter Warsaw Convention].

[207] Protocol to Amend the Convention for the Unification of Certain Rules Relating to International Carriage by Air Signed at Warsaw on 12 October 1929, 478 U.N.T.S. 371 (28 Sept. 1955) [hereinafter Hague Protocol].

[208] Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface, 310 U.N.T.S. 181 (7 Oct. 1952) [hereinafter Rome Convention]. Several major aviation states, such as the United States, are not parties to this treaty.

non-governmental entities. As expounded upon in the Liability Convention,[209] private parties damaged by space objects cannot present claims directly against the operator or launching state, a state must present the claim to the launching state on behalf of the private party. A restriction to note is that nationals of the launching state may not pursue claims against that state under the space law instruments. Likewise, foreign nationals participating in the launch and return of the space object cannot pursue claims against the launching state for any damage they suffer that is caused by the space object. It also should be noted that under the Liability Convention, states are absolutely liable for damage their space objects cause on earth or to aircraft in flight; they are only liable for damage caused to foreign space objects located elsewhere than on the surface of the earth if the launching state is shown to have been at fault. There is no limit on the amount of damages the state may have to pay on a claim (however, there is also nothing that prohibits states from recouping from private entities payments made for damage caused by privately-owned space objects). In contrast, the Warsaw Convention provides for fault-based, limited liability, and the Rome Convention provides for limited, but strict, liability.

Both regimes have registration requirements. The Chicago Convention requires states to provide reports to ICAO on the ownership and control of aircraft registered in the state and engaged in international air transport. The state need only provide this information once. The Registration Convention[210] requires states to maintain a registry listing each space object launched into earth orbit and beyond each time it is so launched. States also must provide certain information to the U.N. Secretary-General, as soon as practicable, on the space objects contained in the state's registry.

Just as the Chicago Convention requires aircraft to carry registration certificates, it also requires aircraft to possess airworthiness certificates. Space law

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[209] Convention on the International Liability for Damage Caused by Space Objects, 961 U.N.T.S. 187, 24 U.S.T. 2389, T.I.A.S. No. 7762 (29 Mar. 1972) [hereinafter Liability Convention].

[210] Convention on Registration of Objects Launched into Outer Space, 1023 U.N.T.S. 15, 28 U.S.T. 695, T.I.A.S. No. 8480 (12 Nov. 1974) [hereinafter Registration Convention].

does not have a requirement comparable to air law's airworthiness restrictions. Consequently, there are no minimum international standards that spaceplanes and other space objects have to meet.

Another definitional problem to consider is that the text of the Chicago Convention does not define 'aircraft,' and the Outer Space Treaty does not define 'spacecraft,' 'space vehicle,' or 'space object.' Annex 7 to the Chicago Convention does contain a definition of 'aircraft,' stating that it is "any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface."[211] In contrast, the definition of 'space object' contained in the Registration Convention and the Liability Convention is not really much of a definition. These treaties state that the "term 'space object' includes component parts of a space object as well as its launch vehicle and parts thereof."[212] Like the Outer Space Treaty, these and other space law instruments do not define 'spacecraft' or 'space vehicle.'

Lastly, it should be noted that the Outer Space Treaty requires states to "regard astronauts as envoys of mankind," who, if they have an accident or make a distress or emergency landing in another state's territory, "shall be safely and promptly returned to the State of registry of their space vehicle."[213] Aircraft commanders and pilots have no such special status under the air law instruments. The implications of the various differences between the two legal regimes as they may pertain to spaceplanes and the boundary and space object issues are discussed in Chapter V.

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[211] ICAO Doc., Annex 7, "Aircraft Nationality and Registration Marks" (July 1981) at 7.

[212] Registration Convention, *supra* note 210, at Article I(b); Liability Convention, *supra* note 209, at Article I(d).

[213] Outer Space Treaty, *supra* note 178, at Article V. This principle is elaborated in the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, 672 U.N.T.S. 119, 19 U.S.T. 7570, T.I.A.S. No. 6599 (2 Apr. 1968) [hereinafter Rescue Agreement].

CHAPTER III

The Lack of a Boundary Between Airspace and Outer Space, Part II: Approaches to the Boundary Issue

A. Background Information on the Debate

The question of the boundary between airspace and outer space has been debated since the dawn of the Space Age. Despite the numerous discussions on the issue, in its 1959 report to the U.N. General Assembly, the *Ad Hoc* Committee on the Peaceful Uses of Outer Space did not include the boundary issue in its catalogue of priority matters.[214] The *Ad Hoc* Committee's discussion of the boundary issue is mentioned in a section titled 'Other Problems.' In essence, the *Ad Hoc* Committee concluded that there was no consensus regarding an airspace/outer space demarcation in light of the existence of numerous, conflicting proposals, and questioned whether there was even a need for a boundary.[215] The Committee stated that

> [i]t was generally believed that the determination of precise limits for air space and outer space did not present a legal problem calling for priority consideration at this moment. The Committee noted that the solution of the problems which it had identified as susceptible of priority treatment was not dependent upon the establishment of such limits.[216]

When the Legal Subcommittee of the permanent U.N. Committee on the Peaceful Uses of Outer Space (COPUOS) held its first session in 1962, the boundary issue was not on its agenda.[217] However, some members of the Subcommittee recommended that the issue be included in a future agenda.[218] It was not until the sixth

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[214] U.N. *Ad Hoc* COPUOS, Rep. to the U.N.G.A., U.N. Doc. A/4141, 14 July 1959.

[215] *Id.* at 67-68.

[216] *Id.* at 68.

[217] U.N. COPUOS, Rep. of the Legal Subcomm. on the Work of its First Session (28 May - 20 June 1962) U.N. Doc. A/AC.105/6, 9 July 1962 [hereinafter U.N. Doc. A/AC.105/6].

[218] *Id.* at 8.

session of the Legal Subcommittee in 1967 that the boundary issue was placed on that Subcommittee's agenda[219]—in response to a request by the U.N. General Assembly that the Subcommittee begin the "study of questions relative to the definition of outer space."[220] It has been on the agenda ever since.

The French delegate at that 1967 session was the most vocal advocate of establishing a boundary between airspace and outer space. His position was:

> A definition would appear necessary not only as a matter of common sense but also from the point of view of legal science, for, if a new chapter of international law – dealing with the law of outer space – was to be written, people had to know the field to which that law would apply. It was also necessary from the more practical point of view of relations among States, if every precaution was to be taken to prevent and settle possible disputes resulting from the foreseeable expansion of outer space activities. Lastly, it was necessary because all States parties to the [Outer Space] Treaty agreed not to assert their national sovereignty in outer space while retaining their rights in respect of the air space over their territory. They should therefore know exactly what and how much they were giving up, if only to be able to assume, under conditions of real legal security, the national responsibilities they still had.[221]

Because there were several possible means of defining outer space--some of which were based on physical attributes of the air and space environments, others of which were based on functional attributes of the activities and objects in question--some delegates felt uncomfortable attempting to settle the issue without the benefit of expert advice.[222] As a result of its 1967 session, the Legal Subcommittee presented a questionnaire to the Scientific and Technical Subcommittee of COPUOS asking that

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[219] U.N. COPUOS, Rep. of the Legal Subcomm. on the Work of its Sixth Session (19 June - 14 July 1967) U.N. Doc. A/AC.105/37, 14 July 1967, Item 4(a).

[220] U.N.G.A. Res., Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space Including the Moon and Other Celestial Bodies (25 Jan. 1967) U.N. Doc. A/Res/2222 (XXI).

[221] U.N. COPUOS, Summary Record (Provisional) of the 80th Meeting of the Legal Subcomm. (5 July 1967) U.N. Doc. A.AC.105/C.2/SR.80, 6 July 1967, at 4 [hereinafter U.N. Doc. A.AC.105/C.2/SR.80].

[222] *See, e.g., id.;* U.N. COPUOS, Summary Record of the 81st Meeting of the Legal Subcomm. (5 July 1967) U.N. Doc. A.AC.105/C.2/SR.81, 16 Aug. 1967 [hereinafter U.N. Doc. A.AC.105/C.2/SR.81].

they "draw up a list of scientific criteria that could be helpful to the Legal Sub-Committee in its study relative to a definition of outer space,"[223] and

> to give its views on the selection of scientific and technical criteria that might be adopted by the Legal Sub-Committee, and to indicate, on scientific and technical grounds, the advantages and disadvantages of each of them in relation to the possibility of a definition which would be valid for the long-term future.[224]

The Scientific and Technical Subcommittee reported to the Legal Subcommittee that "it is not possible at the present time to identify scientific or technical criteria which would permit a precise and lasting definition of outer space."[225] The Scientific and Technical Subcommittee stated that it would continue to consider the issue at future sessions because "a definition of outer space, on whatever basis recommended, is likely to have important implications for the operational aspects of space research and exploration."[226] In fact, they did not address the issue any further.

As a result of its eighth session in 1969, the Legal Subcommittee requested that COPUOS invite the U.N. Secretary-General to prepare a background paper

> on the question of the definition and/or the delimitation of outer space, taking into account both the data provided by the study carried out by the Legal Sub-Committee and the Scientific and Technical Sub-Committee, and also the contributions, studies, data and documents which may be obtained from the specialized agencies concerned and such other international and national organizations and institutions which are interested in the subject as may be determined [by COPUOS].[227]

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[223] U.N. COPUOS, Rep. to the U.N.G.A. (22nd Session) U.N. Doc. A/6804, 27 Sept. 1967, Annex III, at 8 [hereinafter U.N. Doc. A/6804].

[224] *Id.*

[225] *Id.*, Annex II, at 4.

[226] *Id.*

[227] U.N. COPUOS, Rep. to the U.N.G.A. (24th Session) U.N. GAOR Supp. No. 21, U.N. Doc. A/7621 (1969) Annex III, para. 13B.

The Secretary-General complied and presented the Legal Sub-Committee with a comprehensive survey of the existing proposals for a boundary. The study made the same points that the *Ad Hoc* Committee made in its 1959 report to the General Assembly, namely that the issue was complex; that there were numerous, conflicting proposals, none of which had gained general support among states; and that there was still a question as to whether there was even a need to define outer space.[228] The study made no recommendation regarding resolution of the boundary issue.

In conducting the study, the Secretary-General asked ICAO for input, since any limit establishing the beginning of outer space would likely delimit territorial airspace also. Then, as now, ICAO generally viewed the boundary issue as of interest to the air law community, but not necessarily critical to the administration of the air law regime. Hence, they responded first that the principle of state sovereignty over superjacent airspace was fundamental; secondly, that ICAO was concerned with the question of state sovereignty in airspace only as it pertained to aircraft; thirdly, that "from the point of view only of aviation, airspace is only that space in which an aircraft [as defined in Annex 7 to the Chicago Convention], as such, can operate;" and fourthly, that the then maximum altitude of aircraft was 35 km, although future technology might later enable aircraft to fly at greater altitudes[229]—implying that ICAO did not believe that aircraft and space objects would share the same space. It also appears, that at least in 1970, ICAO subscribed to the belief, as did some air and space lawyers, that the lower

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[228] U.N. Secretariat, Background Paper, "The Question of the Definition and/or the Delimitation of Outer Space," U.N. Doc. A/AC.105/C.2/7, 7 May 1970, at 66 (this aged, but comprehensive, catalogue of proposals is still useful for understanding the boundaries that have been suggested over time) [hereinafter Background Paper]; *see also* U.N. Secretariat, Background Paper, "The Question of the Definition and/or the Delimitation of Outer Space," U.N. Doc. A/AC.105/C.2/7, Addendum 1, 21 Jan. 1977 (updating the 1970 Background Paper). There are several other scholarly works that contain detailed discussions of the various boundary proposals. Examples of these works include R.F.A. Goedhart, *The Never Ending Dispute: Delimitation of Air Space and Outer Space* (France: Editions Frontières, 1996) [hereinafter Goedhart]; R.H. Farris, *The Problem of Delimitation in Space Law* (Doctoral Thesis, Univ. of Notre Dame, Indiana, 1974); M.S. McDougal, H.D. Lasswell, and I.A. Vlasic, *Law and Public Order in Space* (New Haven, CT: Yale Univ. Press, 1963) 323-55 [hereinafter McDougal].

[229] Background Paper, *supra* note 228, Annex, at 1. For the Chicago Convention's Annex 7 definition of 'aircraft,' *see supra* note 211 and accompanying text.

boundary of outer space does not necessarily coincide with the upper limit of airspace.[230] More recently, the ICAO Observer to COPUOS pointed out that ICAO has accepted its responsibility "for stating the position of international civil aviation on all related outer space matters."[231] The ICAO Observer acknowledged that the "definition and delimitation of outer space would . . . have as a direct consequence the definition and delimitation of airspace," and pointed out that ICAO has not attempted to define or delimit airspace because "no practical need has arisen in that respect,"[232] and besides, neither ICAO member states nor the U.N. have requested that the organization undertake such an initiative.[233]

Thus, the Legal Subcommittee basically has been left to resolve the boundary issue without much assistance from the Scientific and Technical Subcommittee or ICAO. To understand the difficulty it is having resolving the issue, it is helpful to review some of the arguments for and against establishing a boundary.

B. Arguments for Delimitation

On one side of the boundary debate are those who believe that it is not prudent to leave the issue unresolved. For example, Professor Cooper believed that it was important to establish a boundary, and he put forth several proposals over a number of years to assist states.[234] Some jurists argue that, as a minimum, 'airspace' should be

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[230] *See, e.g.*, J.C. Cooper, "Fundamental Questions of Outer Space Law," *Explorations in Aerospace Law*, I.A. Vlasic, ed. (Montreal: McGill Univ. Press, 1968) 289 [hereinafter Cooper]; American Bar Foundation, *supra* note 24, at 49. *Cf.* Fawcett, *supra* note 165, at 22-23 ("the lower limit of space in relation to the Earth must, in absence of any other agreed limit, constitute the upper limit of the exclusive jurisdiction and control of states over objects above their territory").

[231] *See* ICAO Doc. C-WP/8158, *supra* note 203.

[232] *Id.*

[233] *Id.*

[234] *See, e.g.*, Cooper, *supra* note 230, at 289, 291 (stating that outer space should be defined as "the area whose lower or inner boundary is the lowest altitude above the earth's surface at which an artificial satellite may be put in orbit at least once around the earth, and whose upper or outer boundary is the outer limit of our solar system"); *see also infra* note 284 and accompanying text.

defined so that the applicability of the sovereignty principle of existing air law treaties and regulations is clarified.[235] The belief here is that certainty as regards the boundary between airspace and outer space would prevent states from unreasonably arguing that certain space activities violate their national airspace sovereignty.[236] Indeed, some states, in contending that a boundary is necessary, have pointed out that some of the most heated disputes between states arose due to territorial matters.[237] Other jurists argued that even if a general boundary between airspace and outer space is not established, then there at least should be limited-purpose boundaries to cover specific issues. For example, a boundary could be set that would be used only to determine where ICAO's authority ends, or to determine only where a state's jurisdiction ends.[238]

Professor Voûte advocated limited-purpose boundaries. He presented a cogent argument that, if states conclude a treaty for the prevention of an arms race in outer space, the instrument also should establish a boundary at a specific altitude.[239] He

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[235] *See* American Bar Foundation, *supra* note 24, at 48; *see also* A.D. Terekhov, "Passage of Space Objects Through Foreign Airspace," *Proceedings of the Thirty-second Colloquium on the Law of Outer Space* (Washington, D.C.: AIAA, 1990) 50, 53; M. Benkö and J. Gebhard, "The Definition/ Delimitation of Outer Space and Outer Space Activities Including Problems Relating to the Free ('Innocent') Passage of Spacecraft Through Foreign Airspace for the Purpose of Reaching Orbit and Returning to Earth," *International Space Law in the Making*, M. Benkö and K.-U. Schrogl, eds. (France: Editions Frontières, 1993) 111, 134 [hereinafter Benkö]; M.N. Andem, *International Legal Problems in the Peaceful Exploration and Use of Outer Space* (Finland: Univ. of Lapland, 1992) 153 [hereinafter Andem].

[236] Background Paper, *supra* note 228, at 56.

[237] *See, e.g.*, U.N. COPUOS, Summary Record of the 392nd Meeting of the Legal Subcomm. (5 Apr. 1983) U.N. Doc. A/AC.105/C.2/SR.392, 7 April 1983, at 3 (the USSR delegate to the COPUOS Legal Subcommittee stated, "the most acrimonious conflicts between States arose over territorial issues, and her delegation was loath to allow the greatest achievement of mankind, which should bring benefit to all peoples, to be a source of misunderstanding and dissent between States") [hereinafter U.N. Doc. A/AC.105/C.2/SR.392].

[238] Background Paper, *supra* note 228, at 56.

[239] C. Voûte, "Boundaries in Space," *Peaceful and Non-Peaceful Uses of Space*, B. Jasani, ed. (New York: Taylor & Francis, 1991) 19 [hereinafter Voûte]. Professor Voûte recommended that, for purposes of a treaty preventing an arms race in outer space, the boundary should be set at 100 km. He asserted that establishing a boundary at 100 km is logical because that is the general altitude at which the physical composition of the atmosphere is such that a satellite can orbit the earth without experiencing the air drag that would cause it to burn up or re-enter the earth's atmosphere. *Id.* at 26.

pointed out that such a treaty would prohibit certain, if not all, space weapons. He also pointed out that some of the activities that the treaty would prohibit would likely be permissible if they occurred in airspace. Therefore, he concluded, a boundary is pragmatic and necessary for monitoring compliance with the treaty's prohibition of space weapons and for determining whether certain activities are taking place only where they are authorized.[240] Professor Voûte emphasized, however, that

> the adoption of such an arbitrary boundary between air space and outer space within the context of a specific treaty should not be construed or accepted as a precedence as '*the* boundary between air space and outer space' in the sense of international space law. Therefore, it need not be more generally applicable in other cases where the delimitation between air space and outer space is under consideration.[241]

There is also the argument that if there had been an established boundary, states could have rejected outright the claims of sovereignty over the geostationary orbit made by equatorial states in the Bogotá Declaration of 1976.[242] Professor Goedhuis took this position.[243] He stressed that claims such as those made by the equatorial

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[240] *Id.* at 22, 23.

[241] *Id.* at 34 (emphasis in original).

[242] Declaration of the First Meeting of Equatorial Countries, 3 Dec. 1976, *reprinted in* Goedhart, *supra* note 228, at 153. In the Bogotá Declaration, eight equatorial states proclaimed that, in light of the physical relationship of the geostationary orbit to the earth's equator, that orbit, located at approximately 36,000 km, is not part of outer space, but is subject to the national sovereignty of the subjacent equatorial states. This assertion was not rejected outright by COPUOS, who, instead, added the issue to its agenda in connection with the boundary item. In recent years, the equatorial states appear to have backed off of their claim that the geostationary orbit is not part of outer space. Instead, they now advocate the development of a new, separate legal regime to govern that orbit. It is this issue of a *sui generis* regime for the geostationary orbit that COPUOS's Legal Subcommittee is currently considering. *See, e.g.*, P. Malanczuk, *Akehurst's Modern Introduction to International Law* (London: Routledge, 1997) 203; *see also* U.N. COPUOS Legal Subcomm., Working Paper of Colombia, U.N. Doc. A/AC.105/C.2/L.200 and Corr. 1, 1996 (proposing a *sui generis* legal regime).

[243] *Recueil des Cours*, *supra* note 162, at 390, 404; *see also* Goedhuis, *supra* note 177, at 255

states demonstrated "that the absence of a rule of positive international law by which the term 'outer space' is precisely defined, can lead to serious conflicts."[244]

Among the states supporting a boundary is Italy. In 1967, Italy's delegate to COPUOS said that "it is necessary, and indeed urgent, in order to obviate all uncertainty and possible friction and quarrels between States, to determine how far air space extends and where outer space begins."[245]

States that have more recently expressed support for a boundary during Legal Subcommittee debates include Mexico, whose delegate stated "we note with concern that some . . . believe that this [boundary] item should be removed from the agenda. The Mexican delegation does not share that view. On the contrary, we are convinced of the relevance of establishing a delimitation between airspace and outer space."[246] The Indonesian delegate said that his country "regarded delimitation as essential, since the boundary between airspace and outer space would have a direct impact on the territorial boundaries of sovereign States."[247] France, which was so insistent in 1967 that a boundary be established, still supports resolution of the issue, but has adopted a more cautious argument. This caution is reflected in a statement by its delegate that the issues and consequences of a boundary must be carefully considered so that "constraints would not be placed on the principle of free access to and free return from outer space."[248] Also favoring a boundary is Chile, whose delegate asserted that "[a]ny comprehensive reading of the [1967 Outer Space] Treaty led to the inescapable

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[244] *Recueil des Cours, supra* note 162, at 390; *accord* L. Perek, "Delimitation of Air Space and Outer Space: Is it Necessary?" *excerpted in Public International Air Law I: Documents and Materials*, I.A. Vlasic, ed. (Montreal: McGill Univ., 1989) 161 [hereinafter "Delimitation of Air Space"].

[245] U.N. Doc. A/6804, *supra* note 223, Annex III, at 74.

[246] U.N. COPUOS, Verbatim Record of the 360th Meeting of COPUOS, Rep. of the Legal Subcomm. on the Work of its 30th Session (3 June 1991) U.N. Doc. A/AC.105/PV.360, 9 July 1991, at 46 [hereinafter U.N. Doc. A/AC.105/PV.360].

[247] U.N. COPUOS, Summary Record of the 559th Meeting of the Legal Subcomm. (6 Apr. 1992) U.N. Doc. A/AC.105/C.2/SR.559, 8 Apr. 1992, at 2 [hereinafter U.N. Doc. A/AC.105/C.2/SR.559].

[248] *Id.* at 4.

conclusion that the definition and delimitation of outer space were necessary."[249] Other states believing that the issue needs to be resolved include the Russian Federation,[250] India,[251] Argentina,[252] China,[253] and Colombia.[254]

In its more recent reports to the U.N General Assembly, COPUOS provided the following summary of the arguments made by proponent states during debates on the issue:

> Some delegations reiterated the view that a conventionally defined boundary between airspace and outer space was needed and that the Legal Subcommittee should continue to consider the question, with a view to establishing such a boundary. In that regard, the view was expressed that a delimitation between airspace and outer space was necessary in order to clearly establish which activities would be governed under the sovereignty of States and which under the *res communis omnium*.[255]

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[249] *Id.* at 6.

[250] U.N. COPUOS, Summary Record of the 560th Meeting of the Legal Subcomm. (8 Apr. 1992) U.N. Doc. A/AC.105/C.2/SR.560, 13 Apr. 1992, at 8 (noting that its delegation has put several proposals before the COPUOS Legal Subcommittee in an attempt to resolve the issue) [hereinafter U.N. Doc. A/AC.105/C.2/SR.560]; *see also infra* notes 276-278 and accompanying text. The proposals to which the Russian Federation refers were submitted by its predecessor, the Soviet Union. Initially, the Soviet Union did not support a spatial boundary. For years, they, like the United States, opposed the establishment of a boundary as premature and unnecessary. Their position possibly changed in order to counter the Bogotá Declaration of 1976.

[251] U.N. Doc. A/AC.105/C.2/SR.559, *supra* note 247, at 4 ("the definition and delimitation of outer space limits would promote its peaceful use and demilitarization").

[252] U.N. COPUOS, Summary Record of the 558th Meeting of the Legal Subcomm. (3 Apr. 1992) U.N. Doc. A/AC.105/C.2/SR.558, 7 Apr. 1992, at 2 ("it [is] necessary to determine the limit between airspace and outer space, as each [is] subject to a different legal regime") [hereinafter U.N. Doc. A/AC.105/C.2/SR.558].

[253] U.N. Doc. A/AC.105/PV.360, *supra* note 246, at 26 (stating that the issue needs to be addressed).

[254] *Id.* at 37 ("[W]e wholeheartedly support[ ] the proposals made by the Soviet Union. Our delegation believes that vital, new, autonomous space law is being elaborated. Surely, it is essential to determine its scope of application—where it starts, where it ends, how far it goes, in what circumstances the principles should apply.").

[255] U.N. COPUOS, Rep. to the U.N.G.A. (51st Session) U.N. GAOR Supp. No. 20, U.N. Doc. A/51/20 (1996) para. 125 [hereinafter U.N. Doc. A/51/20]; *see also* U.N. COPUOS, Rep. to the U.N.G.A. (50th Session) U.N. GAOR Supp. No. 20, U.N. Doc. A/50/20 (1995) para. 115 (substantially similar

In its 1996 report to COPUOS, the Legal Subcommittee described the arguments of those in favor of a boundary by stating that "[s]ome delegations expressed the view that the whole issue of 'definition and delimitation' was of paramount interest and importance for States and that a 'responsible approach' and/or a 'cautious approach' should govern the conduct of Governments when tackling the issue."[256] The Subcommittee's 1997 report stated that "[t]he view was expressed that the Legal Subcommittee should make further efforts to resolve the issue of the definition and delimitation of outer space, and that it should continue . . . its work."[257]

1. Spatial Approaches to a Boundary

The vast majority of boundary proposals fall within a category referred to as 'spatial boundaries.' These boundaries are either based on the physical aspects of the airspace and/or outer space, or they are based on a specific altitude. Following is a description of a few of these proposals.

One of the more popular suggestions for a boundary is that of the lowest perigee achieved by orbiting satellites.[258] In 1968, the International Law Association (ILA) suggested that 'outer space' be interpreted as including

> all space at and above the lowest perigee achieved by the 27th January 1967, when the [Outer Space] Treaty was opened for signature, by any satellite put into orbit, without prejudice to the question whether it may or may not later be determined to include any part of space below such perigee.[259]

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language) [hereinafter U.N. Doc. A/50/20]; U.N. COPUOS, Rep. to the U.N.G.A. (49th Session) U.N. GAOR Supp. No. 20, U.N. Doc. A/49/20 (1994) para. 114 (substantially similar language; but adding that "[t]he view was also expressed that after 35 years of discussion about the definition and delimitation of outer space, a choice should be made for either a functional or a spatial approach or that it should be decided to let the whole question rest for the time being") [hereinafter U.N. Doc. A/49/20].

[256] U.N. COPUOS, Rep. of the Legal Subcomm. on the Work of its 35th Session (18 - 28 Mar. 1996) U.N. Doc. A/AC.105/639, 11 Apr. 1996, para. 11 [hereinafter U.N. Doc. A/AC.105/639].

[257] U.N. COPUOS, Rep. of the Legal Subcomm. on the Work of its 36th Session (1 - 8 Apr. 1997) U.N. Doc. A/AC.105/674, 14 Apr. 1997, para. 8 [hereinafter U.N. Doc. A/AC.105/674].

[258] *See, e.g.*, Goedhart, *supra* note 228, at 47-53; Background Paper, *supra* note 228, at 45-47.

Several jurists and commentators indeed have expressed a belief that the lowest perigee of orbiting satellites constitutes the demarcation of outer space.[260] Moreover, Professors Danilenko and Vereshchetin asserted that this belief is a matter of customary international law.[261] States that have supported the position that points beyond the lowest perigee achieved by orbiting satellites constitute outer space include the former USSR[262] and the former Czechoslovakia.[263]

Noting that technology improvements could lead to satellites able to orbit at increasingly lower levels, proponents of this version of the 'lowest perigee' approach usually focus on a boundary of about 100 km.[264] Indeed, the ILA later abandoned the idea of connecting the boundary to the lowest perigee achieved as of a specific date, and instead asserted that "the space at and above the altitude of about 100 km above sea level has been growingly acknowledged by states as well as by experts in the field

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[259] International Law Association, Space Law Resolution, *Report of the 53rd Conference of the International Law Association*, Buenos Aires, Aug. 1968 (London: ILA, 1969) xxii.

[260] *See e.g.*, Wassenbergh, *supra* note 200, at 15; American Bar Foundation, *supra* note 24, at 48; Gorove, *supra* note 9, at 21; *Recueil des Cours, supra* note 162, at 394-97.

[261] V.S. Vereshchetin and G.M. Danilenko, "Custom as a Source of International Law of Outer Space," 13 *J. Sp. L.* 22, 27 (1985).

[262] U.N. Doc. A/AC.105/C.2/SR.392, *supra* note 237, at 4.

[263] U.N. COPUOS, Summary Record of the 394th Meeting of the Legal Subcomm. (6 Apr. 1983) U.N. Doc. A/AC.105/C.2/SR.394, 8 Apr. 1983, at 3 [hereinafter U.N. Doc. A/AC.105/C.2/SR.394].

[264] B. Cheng, "The Legal Regime of Airspace and Outer Space: The Boundary Problem; Functionalism versus Spatialism: The Major Premises," *Studies in International Space Law* (New York: Oxford Univ. Press, 1997) 450 [hereinafter "The Boundary Problem"]. *See also* Wassenbergh, *supra* note 200, at 15 (pointing out that 90 km was the lowest perigee of Sputnik when it orbited Earth in 1957). *Contra* statements of the British delegate to COPUOS. In 1967, that delegate said,

> So far no State had claimed that its sovereignty extended to areas corresponding to the lowest perigee of objects in orbit. Moreover, in practice, any object in orbit was now regarded as being 'in space.' There had been a suggestion that the boundary between air space and outer space should be fixed at the altitude at which an unpowered satellite would orbit the earth at least once. However, since earlier estimates of the lowest possible perigee for such a satellite had had to be revised, the scientific validity of that suggestion would have to be examined.

U.N. Doc. A/AC.105/C.2/SR.81, *supra* note 222, at 3.

of outer space activities as outer space."[265] It is generally believed that most stand-alone satellites cannot orbit much lower than 90 km without falling to earth.[266] The cost it would take to build satellites that could withstand the friction and gravitational pull at lower altitudes is thought to be so enormous as to be prohibitive.[267]

It is unlikely that the United States would support 100 km as a boundary because it has had objects orbiting at lower altitudes. For example, in July 1995, in accordance with the Registration Convention,[268] the U.S. reported that it launched a spacecraft whose lowest perigee was 95 km.[269] In 1993, the U.S. reported that it launched a spacecraft whose lowest perigee was 78 km, and that "spent boosters, spent manoeuvring stages, shrouds and other non-functional objects" were also orbiting as low as 78 km.[270] Under the 'lowest perigee' theory, these objects could be considered to violate the national airspace of the subjacent state(s).

Closely related to the 'lowest perigee' approach is the proposal that an arbitrary altitude be selected as the boundary. Most of these proposals also settle on a boundary of 100 km, while others have selected 80 km[271]—a boundary that still would not

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[265] International Law Association, Space Law Resolution, *Report of the 58th Conference of the International Law Association*, Manila, Sept. 1978, *excerpted in Space Law and Institutions: Documents and Materials,* I.A. Vlasic, ed. (Montreal: McGill Univ. 1997) 153.

[266] L. Perek, "Scientific Criteria for the Delimitation of Outer Space," 5 *J. Sp. L.* 111, 118 (1977) [hereinafter Perek]; *see also* Voûte, *supra* note 239, at 26.

[267] Perek, *supra* note 266, at 119.

[268] Registration Convention, *supra* note 210.

[269] U.N. Secretariat, Information Furnished in Conformity With the Convention on Registration of Objects Launched Into Outer Space—United States, U.N. Doc. ST/SG/SER.E/288, 27 July 1995 [hereinafter U.N. Doc. ST/SG/SER.E/288].

[270] U.N. Secretariat, Information Furnished in Conformity With the Convention on Registration of Objects Launched Into Outer Space—United States, U.N. Doc. ST/SG/SER.E/258, 7 Jan. 1993.

[271] *See, e.g., Introduction to Space Law, supra* note 10, at 18 (recommending a 100km boundary); Andem, *supra* note 235, at 152 (stating that from a theoretical, technological, and scientific standpoint, 80km would adequately protect all interests).

provide a legal haven for objects such as some of those the U.S. registered with the U.N. Secretariat in 1993.

Proponents of the 'lowest perigee' and 'arbitrary line' theories believe that an 80 -100 km boundary still leaves ample national airspace for subjacent states. This belief fits in with the position of those who say that the air law regime is primarily concerned with the airspace up to the point of the highest altitude at which aircraft can fly.[272] Of course, improvements in aircraft technology could enable them to fly higher and higher; but it is believed that, at about 80 km and higher, there is "insufficient aerodynamic lift to sustain any currently conceived heavier-than-air winged aircraft."[273] Nevertheless, the maximum altitude at which aircraft can fly also has been proposed as a boundary. This theory is based on the definition of 'aircraft' found in Annex 7 to the Chicago Convention.[274] It is criticized not only on the grounds that the highest altitude at which aircraft can fly could increase with technological improvements, but also on the grounds that it was not within the contemplation of the drafters of the Chicago Convention to delimit airspace—they were only concerned with aircraft.[275]

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[272] *See supra* text accompanying note 229.

[273] American Bar Foundation, *supra* note 24, at 6. A related spatial approach is the Kármán primary jurisdictional line, which is based on the notion that outer space should begin, and airspace end, at the point where aircraft no longer encounter sufficient air in the atmosphere from which to derive aerodynamic lift. Dr. von Kármán derived this boundary in 1957 by considering biological, physiological, mechanical, and thermodynamic factors; and the upward pressure of air. He concluded that the boundary between airspace and outer space lies at about 275,000 feet (approximately 83 km) above the earth's surface. *See generally, Introduction to Space Law, supra* note 10, at 16; Goedhart, *supra* note 228, at 61-63; Background Paper, *supra* note 228, at 43-45.

[274] *See supra* note 211 and accompanying text.

[275] Background Paper, *supra* note 228, at 43; *see also*, McDougal, *supra* note 228, at 329; V. Kopal, "Issues Involved in Defining Outer Space, Space Object and Space Debris," *Proceedings of the Thirty-fourth Colloquium on the Law of Outer Space* (Washington, D.C.: AIAA, 1992) 38, 39; U.N. *Ad Hoc* COPUOS, Summary Record of the First Meeting of the Legal Committee (26 May 1959) U.N. Doc. A/AC.98/C.2/SR.1, 30 June 1959, at 7 (The British delegate to *Ad Hoc* COPUOS stated that "the body of customary and conventional international law relating to international civil aviation did not seem to be automatically applicable to activities in outer space, since it was concerned only with aircraft operating in air space.").

A boundary proposal recommended by the Soviet Union, which is still under consideration by COPUOS, is that of 110 km.[276] They recommended that:

> The boundary between outer space and air space shall be established by agreement among States at an altitude not exceeding 110 km above sea level, and shall be legally confirmed by the conclusion of an international legal instrument of a binding character.[277]

The bases for this proposal are similar to those presented for the 'lowest perigee' theory, but for the most part, it is an arbitrary boundary. As discussed in Chapter II, the proposal also asserts that space objects currently have a right of innocent passage through foreign airspace:

> This instrument shall also specify that a space object of any State shall *retain* the right of innocent (peaceful) passage over the territory of other States at altitudes lower than the agreed boundary for the purpose of reaching orbit or returning to earth.[278]

Not only have COPUOS members not yet issued a decision on the Soviet boundary proposal, they also have not formally addressed the "innocent passage" component of the proposal.[279] Based on the historical position of most states that there is no such right, it is unlikely that COPUOS will support the innocent passage provision if it otherwise decides to recommend that states accept the 110 km boundary proposal.

Another proposal was that the upper limit of the atmosphere become the boundary.[280] This theory is unworkable because the outermost layers of the atmosphere stretch upwards from about 500 miles (approximately 800 km) until the

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[276] U.N. Doc. A/AC.105/C.2/L.139, *supra* note 189; *see also* Goedhart, *supra* note 228, at 4-5.

[277] U.N. Doc. A/AC.105/C.2/L.139, *supra* note 189.

[278] *Id.* (emphasis added).

[279] *See* Vlasic, *supra* note 190, at 37.

[280] *See, e.g.* Goedhart, *supra* note 228, at 31-34; Background Paper, *supra* note 228, at 36; Jenks, *supra* note 164, at 116 (in this theory, "airspace" is equated with the "atmosphere").

atmosphere merges imperceptibly with interplanetary space.[281] It should be noted that there are almost as many different dimensions given for the atmospheric layers as there are those who describe them.[282] The 500-mile figure is provided here as just one example illustrating that the atmosphere is not a feasible boundary because its limits encompass areas in which satellites can orbit. According to the U.N. space object registry, numerous objects have orbited at altitudes lower than 500 miles/800 km.[283]

Another recommendation is that the atmosphere be divided into three zones. Activities occurring in the lowest zone would be considered to occur in national airspace, and therefore subject to the air law principle of sovereignty of the subjacent state. The outer zone would be considered 'outer space,' and therefore subject to the space law principles of freedom and non-appropriation. States would have a right of

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[281] American Bar Foundation, *supra* note 24, at 6; Goedhart, *supra* note 228, at 29; *see also* N.M. Matte, "Introductory Comments on the Aerospace Medium," *Proceedings of the Twentieth Colloquium on the Law of Outer Space* (Littleton, CO: U.C.-Davis, CA, 1978) 47 (pointing out that the exosphere has been said to extend as far up as 20,000 km).

[282] "The Boundary Problem," *supra* note 265, at 451 (depicting a graph which shows that numerous satellites have had low perigees in the 90 - 150 km range). Some sources say low earth orbit (LEO) begins at about 60 miles (96 km). *See, e.g.,* "Space Almanac," *Air Force Magazine* (Aug. 1995) http://www.afa.org/31.html (accessed: 9 June 1998). Others say that LEO begins at about 281 miles (450 km) and that near-earth-orbit starts at 94 miles (150 km). *See, e.g.,* S. Mosteshar, "Development of the Regime for the Low Earth Orbit and the Geostationary Orbit," *Outlook on Space Law Over the Next 30 Years*, G. Lafferranderie and D. Crowther, eds. (The Hague: Kluwer, 1997) 81, 81-82.

[283] *See, e.g.,* U.N. Secretariat, Information Furnished in Conformity With the Convention on Registration of Objects Launched Into Outer Space—United States, U.N. Doc. ST/SG/SER.E/319, 8 Apr. 1997 (The American report included space objects with perigees of 217km, 225km, 288km, 343km, and 469km); U.N. Secretariat, Information Furnished in Conformity With the Convention on Registration of Objects Launched Into Outer Space—Russian Federation, U.N. Doc. ST/SG/SER.E/313, 1 Aug. 1996 (The Russian Federation reported space objects with perigees of 175km, 189km, 194km, 199km, and 261km); U.N. Secretariat, Information Furnished in Conformity With the Convention on Registration of Objects Launched Into Outer Space—China, U.N. Doc. ST/SG/SER.E/312, 1 Aug. 1996 (The Chinese report included space objects with perigees of 178.2km, 184.5km, 187.9km, 200.2km, and 205.8km); U.N. Secretariat, Information Furnished in Conformity With the Convention on Registration of Objects Launched Into Outer Space—Russian Federation, U.N. Doc. ST/SG/SER.E/292, 12 Oct. 1995 (The Russian Federation reported space objects with perigees of 177km and 413km); U.N. Doc. ST/SG/SER.E/288, *supra* note 269 (The U.S. report included space objects with perigees of 95km, 138km, 156km, 182km, 197km, 234km, 279km, 308km, 485km, 550km, 637km, and 788km); U.N. Secretariat, Information Furnished in Conformity With the Convention on Registration of Objects Launched Into Outer Space—Canada, U.N. Doc. ST/SG/SER.E/283, 23 May 1995 (Canada reported a space object with a perigee of 206km).

innocent passage through the central zone. Professor Cooper was a proponent of this approach to the boundary issue. He referred to the central zone as the 'contiguous zone,' and proposed that, although states would have a right to innocent passage through it, this zone would be subject to the sovereignty of the subjacent state.[284] This theory has been criticized as being arbitrary and unlikely to be acceptable to states in light of the 'innocent passage' component.[285]

Other proponents of the three-zone approach refer to the central zone as 'mesospace.'[286] They likewise agree that states would have a right to innocent passage through mesospace, but propose that the zone be subject to international law, rather than the sovereignty of subjacent states. In this approach, the upper limit of airspace is recommended to be 50 km, and the lower boundary of outer space is placed at 100 km. Because only rocket-powered vehicles and satellites are believed to be able to operate between 50 and 100 km, proponents of this theory believe that space law should be the regime applicable in mesospace. The criticism of this theory, of course, is that if space law applies between 50 and 100 km, and beyond, there is no need for three zones.[287]

Other spatial approaches to a boundary include the point at which the atmosphere rotates with the earth, and the altitude at which the earth's gravitational pull ceases.[288] There was also a proposal to establish the boundary in the electromagnetic field of the atmosphere, and a proposal that it be set at the point where

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[284] J.C. Cooper, "The Boundary Between Territorial Airspace and International Outer Space," *Explorations in Aerospace Law*, I.A. Vlasic, ed. (Montreal: McGill Univ. Press, 1968) 304. Through the years, Professor Cooper proposed varying altitudes for the zone demarcations. One proposal was that the lower zone would reach up to 25 miles (approximately 40 km), the contiguous zone would extend to 75 miles (approximately 120 km), and that outer space was everything beyond that. *Id.*

[285] *See* Goedhart, *supra* note 228, at 71.

[286] *See, e.g., Introduction to Space Law, supra* note 10 at 17; Goedhart, *supra* note 228, at 72-74.

[287] Goedhart, *supra* note 228, at 72.

[288] *See generally*, Goedhart, *supra* note 228; Background Paper, *supra* note 228.

human life can survive without support systems.[289] Others have proposed that one of the layers of the atmosphere be selected as the boundary, while still others proposed that a specific atmospheric pressure or density become the boundary.[290] None of these approaches is considered any more feasible than most of those discussed above.

2. *Functional Approaches to a Boundary*

Some states, such as the United States, and some jurists vigorously object to establishment of a spatial boundary. The primary objection is that spatial boundaries are arbitrary and subject to uncertainty and instability. Nevertheless, many spatial boundary opponents tend to favor a functional approach to determining the applicable legal regime. Rather than focusing on the physical, scientific, and technological properties of airspace and outer space, or the location in which an activity occurs, proponents of the functional approach look to the nature, objectives, and missions of the vehicle or object in question.[291] Basically, the type of activity engaged in, and the flying properties of the vehicle or object, determine whether air or space law applies.[292] For example, if the vehicle meets the definition of 'aircraft' set out in Annex 7 to the Chicago Convention,[293] then air law would apply to that vehicle. Consequently, if a vehicle does not meet the Convention annex's definition of 'aircraft,' and it is intended to move at altitudes higher than aircraft, then space law would apply.[294] Under the

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[289] *See* S. Mishra and T. Pavlasek, "On the Lack of Physical Bases for Defining a Boundary Between Air Space and Outer Space," VII *Ann. Air & Sp. L.* 399, 406 (1982) [hereinafter Mishra].

[290] N.M. Matte, ed., *Space Activities and Emerging International Law* (Montreal: Centre for Research of Air and Space Law, McGill Univ., 1984) 375-76.

[291] *See, e.g., Introduction to Space Law, supra* note 10, at 17; *see also* Wassenbergh, *supra* note 200, at 18 (pointing out that the functional approach subjects the activity to specific rules, regardless of where the activity takes place).

[292] *See* Goedhart, *supra* note 228, at 83; *Introduction to Space Law, supra* note 10, at 17; Background Paper, *supra* note 228, at 58.

[293] *See supra* text accompanying note 211.

[294] *See Introduction to Space Law, supra* note 10, at 18.

functional approach, therefore, there is no need for a line or zone dividing airspace and outer space. Furthermore, the arbitrariness of most spatial approaches is avoided.

Some jurists support the position that the Outer Space Treaty adheres to the functional approach in light of its failure to include a line of demarcation between airspace and outer space, and its focus on activities of states.[295] A criticism of this theory, however, is that the Outer Space Treaty does not define 'space activities.'[296] Besides, even though the question of boundaries was mentioned during the debate that led to the adoption of the Treaty,[297] the issue was not actually discussed at the time.

Professor Wassenbergh believed that some states advocate the functional approach because "it ensures more freedom of operation under existing space law."[298] He pointed out, however, that this approach implies a right to 'innocent passage,' a notion that has not been generally accepted by the international community.[299]

Despite its apparent simplicity, and perhaps because of the 'innocent passage' aspect, the functional approach has not gained significant support. Among its critics is Professor Cheng, who argued that a spatial approach to the boundary issue, rather than a functional approach, is required.[300] In his opinion, the location of an activity must determine whether or not the activity is legal, rather than the nature of the activity. He used the example of the Soviet shoot down of the American U-2 spy plane in 1960 to illustrate his point: Because the shootdown took place over Soviet territory, no one,

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[295] *See, e.g., id.*; G. Gál, "Thirty Years of Functionalism," *Proceedings of the Fortieth Colloquium on the Law of Outer Space* (Reston, VA: AIAA, 1998) 125, 126.

[296] Background Paper, *supra* note 228, at 65.

[297] U.N. Doc. A/AC.105/C.2/SR.80, *supra* note 221, at 4 (When the boundary issue was placed on the U.N. COPUOS Legal Subcommittee's agenda, the French delegate reminded the Subcommittee members that "the French delegation had had occasion more than once to express its views on the subject [of a boundary] during the drafting of the [Outer Space] Treaty.").

[298] Wassenbergh, *supra* note 200, at 18.

[299] *Id.*

[300] Cheng, *supra* note 167, at 389.

not even the United States, asserted that the act was unlawful. However, when the Soviets shot down another U.S. spy plane two months later over the high seas, the U.S. objected on grounds that the act was illegal. As Professor Cheng saw it, both cases involved the same activity (functional) on the part of the U.S., but the determination as to whether or not the Soviet response to that activity was legal turned on the location (spatial) of the aircraft.[301] He claimed that this analogy applies equally to the locus of satellites. Considering the lack of strong support for the functional approach, and believing, like Professor Cheng, that "the element of location is a decisive factor in the choice of the legal régime to be applied," Professor Goedhuis said it is unlikely that states would establish a functional approach to the boundary issue.[302]

3. Other Approaches to the Boundary Issue

Although the majority of proposals for a boundary are either spatial or functional, other ideas have been suggested that do not fall into either category. For example, Professor Christol suggested a third approach after concluding that neither the spatial nor the functional approach is feasible. He pointed out that the spatial proposals largely depend on attributes that might differ over time due to changes in technology or in the atmosphere. He found the functional approach unacceptable because some vehicles, such as hybrid spaceplanes, might have more than one function. His proposal for addressing the boundary issue as regards spaceplanes was that states use an 'allocative' approach. He suggested that:

> a theory should be accepted which is based on the purpose or purposes of the aerospace plane and the effect or effects of its activities. If its purpose is to enter and to return from space while having the capacity to orbit the Earth at least one time, it will be subject to the regime of space law. If, on the other hand, its purpose were to travel through an area in which it would not become orbital, it would fall within the regime of air law. If the

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[301] *Id.*; *accord* Professor Goedhuis, *Recueil des Cours, supra* note 162, at 391 (He stated that the functional approach is unworkable because "it is not possible to take into account solely the kind of space activities, leaving apart the regions where these activities take place. One cannot pretend that the height and locus where these activities are performed are irrelevant.").

[302] *Recueil des Cours, supra* note 162, at 391.

> purpose of the craft were to engage in transportation from one place on Earth even though for a brief time it might be at orbital heights, it would still be treated as an air plane and would be subject to the regime of air law.[303]

If a vehicle has both an aviation purpose and an outer space purpose, then the state that authorized the mission—the launching state—would be responsible for the effects of the vehicle's activities.[304] He acknowledged that statements regarding the purpose of a vehicle could be subjective. But he nevertheless believed that other states could determine a vehicle's purpose by looking at such criteria as its place of departure, its transit pattern, its conduct, and whether it was registered with the U.N.[305]

Another approach suggested that instead of establishing a boundary, states could define outer space indirectly by defining 'objects in space.'[306] This suggestion was presented by Mr. Chandrashekar while discussing a proposal that all space weapons be banned. He believed that, if a treaty prohibiting space weapons is accomplished, states should have some means of determining whether a particular weapon is a 'space weapon.' He stated that one way of making this determination is by looking at whether the weapon possesses certain defined characteristics. For example, one characteristic could be that the weapon is 'in orbit around the earth.' Or, to ensure that ballistic weapons, which do not enter into orbit, are included, the relevant characteristics could be those that define typical ballistic systems. Mr. Chandrashekar acknowledged that this theory's weakness lies in the need to occasionally redefine the various characteristics that make an object a 'space weapon,' because later changes in technology could make those characteristics obsolete. Mr. Chandrashekar's proposal

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[303] C. Q. Christol, "Air and Space Transit, International Law and Space Law: Clarification of Law and Policy," *Proceedings of the Thirty-fourth Colloquium on the Law of Outer Space* (Washington, D.C.: AIAA, 1992) 28 [hereinafter Christol]; *see also* C. Q. Christol, "The aerospace plane: its legal and political future," 9 *Sp. Policy* 35, 42-43 (Feb. 1993) [hereinafter "The aerospace plane"].

[304] Christol, *supra* note 303, at 30.

[305] *Id.*

[306] S. Chandrashekar, "Problems of Definition: A View of an Emerging Space Power," *Peaceful and Non-Peaceful Uses of Space*, B. Jasani, ed. (New York: Taylor and Francis, 1991) 77, 87-88 [hereinafter Chandrashekar].

for dealing with the boundary issue by defining 'objects in space' is related to the current efforts in COPUOS to resolve the issue by defining 'aerospace objects.' This COPUOS effort is discussed in the next chapter.

C. Arguments Against Delimitation

Arguments for establishing a boundary are usually met with the argument that demarcation between airspace and outer space is unnecessary, at least for now. The United Kingdom and the United States are probably the most vocal opponents of a boundary. The British delegate to the Legal Subcommittee of COPUOS has stated that "his country remained unconvinced of the need for a definition and delimitation of the boundary between airspace and outer space."[307] The American delegate has indicated that the U.S. adheres to neither the functionalist nor the spatialist approach to a boundary, but rather to a pragmatic approach.[308] That is, the U.S. delegation believes that the focus should be on whether the progessive conduct of space activities *required* establishment of a boundary, and, in its opinion, it did not.[309] The U.S. called upon proponents to demonstrate exactly why a boundary was needed,[310] but has not yet received a response that it considers compelling. The American delegate later said:

> The absence of a definition or delimitation of outer space, as we are all aware, has not placed practical barriers in the way of the dramatic progress that has been made in the peaceful exploration and utilization

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[307] U.N. Doc. A/AC.105/C.2/SR.560, *supra* note 250, at 2.

[308] U.N. COPUOS, Summary Record of the 396th Meeting of the Legal Subcomm. (7 Apr. 1983) U.N. Doc. A/AC.105/C.2/SR.396, 11 Apr. 1983, at 2 [hereinafter U.N. Doc. A/AC.105/C.2/SR.396].

[309] *Id.* The U.S. delegate stated,

> [t]he only justifiable reason for creating a legal norm was to prevent or cure a problem that would either begin or continue if the norm was not created. That reason did not exist in the present case, since it remained to be shown that the lack of a legal rule defining where outer space began had given rise to practical problems that could be solved only by the creation of such a rule.

Id.

[310] *Id.*

> of outer space over the last 30 years. The continued absence of such a definition or delimitation does not, to our knowledge, pose any obstacles to further dramatic progress for the foreseeable future. Quite to the contrary, as we have consistently emphasized throughout the discussion on this subject, premature attempts to establish such a definition or delimitation may in fact complicate, if not impede, further progress in the peaceful exploration and utilization of outer space.
>
> As our delegation and others have stated on numerous occasions, further consideration of this matter will not be productive. We would urge the Committee to find some way to drop it from the agenda of the Legal Subcommittee or at least to put it to the side so that the time of the Subcommittee could be spent on matters that both address more concrete problems and are more likely to produce practical results.[311]

Other states voicing objections to a boundary include Germany[312] and Romania.[313]

In arguments that it has not been demonstrated that a boundary is needed,[314] it is often pointed out that there have not been any incidents, such as a collision between spacecraft and aircraft in airspace, that would indicate a need for a boundary.[315] Other arguments are that states would have difficulty lowering a boundary once it is established because some states might view that as an infringement on their sovereign

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[311] U.N. COPUOS, Verbatim Record of the 362nd Meeting of COPUOS, Rep. of the Legal Subcomm. on the Work of its 30th Session (4 June 1991) U.N. Doc. A/AC.105/PV.362, 12 July 1991, at 43-44 [hereinafter U.N. Doc. A/AC.105/PV.362]; *see also* Benkö, *supra* note 235, at 133 (summarizing the British and American positions, and referring to them as "a third approach to delimitation").

[312] U.N. Doc. A/AC.105/C.2/SR.560, *supra* note 250, at 4 (stating that the issue had not "reached the stage where the elaboration of legal principles had become necessary," and "[a]ny attempt to force the delimitation of airspace and outer space without a solid basis for determining the relevant criteria would . . . affect the principle of rational and efficient use and might impede the further development of space technology and, consequently, the use of outer space").

[313] U.N. Doc. A/AC.105/PV.362, *supra* note 311, at 23 (It is "premature to attempt to establish in a legal instrument a certain limit between airspace and outer space. At the present time we are not in a position to know all the consequences that such a decision could entail.")

[314] *See, e.g.*, Jenks, *supra* note 164, at 109; S. Rosenfield, "Where Air Space Ends and Outer Space Begins," 7 *J. Sp. L.* 137, 147 (1979).

[315] *See Introduction to Space Law, supra* note 10, at 15; Goedhart, *supra* note 228, at 5. *Contra Recueil des Cours, supra* note 162, at 390 (saying that the claim of equatorial states in the Bogotá Declaration that the geostationary orbit was not a part of outer space presented a conflict that a boundary between airspace and outer space would have addressed); "Delimitation of Air Space," *supra* note 244.

airspace, and "[t]hat an arbitrary line, even if low enough to permit more space activity, might encourage rather than avert disputes because it might provoke technical complaints about violations which at high altitudes would be difficult to verify."[316]

Several jurists have concurred with the American delegates to COPUOS that the issue of a boundary is 'a practical rather than a legal problem,' and that there are practical reasons for not establishing a boundary.[317] For example, Sir William Hildred stated that

> The recognition of national sovereignty in the airspace is something we have to live with for the present, but a practical code of international law does not require a geometric definition of the boundary between airspace and space. Any attempts to define it repeats old errors, is inducive of claims to extended sovereignty, and is dangerous.[318]

The United States has argued in addition that a boundary cannot be discussed intelligently in a vacuum. In the U.S.'s opinion, the issue requires consideration of a number of factors--legal, political, military, economic, technological, and scientific--and no adequate examination of those factors has yet occurred.[319] The "inability of most countries to monitor . . . an altitude boundary" was another reason offered by the U.S.

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[316] L. Lipson and N. D. Katzenbach, *Report to the National Aeronautics and Space Administration on the Law of Outer Space* (Chicago: American Bar Foundation, 1961) 17.

[317] Jenks, *supra* note 164, at 111. *Contra* Goedhuis, *Recueil des Cours, supra* note 162, at 404:

> [w]hen one accepts the supposition that from a practical point of view, the establishment of a definite boundary would—compared with the situation prevailing at the moment—not result in any fundamental change, could it then, on the basis of supposition, perhaps be argued that there is no urgent need to lay down such a rule? Such an argument would not be a valid one. It can hardly be denied that the spheres of application of international law in whatever area, need not be clearly defined and that the establishment of a precise boundary between air space and outer space would lead to greater legal security. Although it would of course not lead to an avoidance of all possible kinds of conflicts, it certainly would limit the chances of legal disputes arising in this field. To give but one example: it would prevent claims of sovereignty over outer space, like those made in the Bogota Declaration.

[318] *See*, Jenks, *supra* note 164, at 111.

[319] U.N. COPUOS, Summary Record of the 316th Meeting of the Legal Subcomm., U.N. Doc. A/AC.105/C.2/SR.316, 4 Apr. 1979, at 2 [hereinafter U.N. Doc. A/AC.105/C.2/SR.316]; *see also* Benkö, *supra* note 235, at 143.

against fixing a boundary.[320] This latter argument can be criticized on grounds that an inability to monitor a boundary is not an adequate reason to forego one. Moreover, not all states are able to monitor launched space objects to ensure that they are listed in the U.N. space object registry, but that has not caused anyone to push for dissolution of that registry, or the Registration Convention's requirements, on those grounds.

Although the most common proposals for a boundary are numerical in nature, it is commonly argued that the proposals for establishing a boundary at a certain altitude should be rejected as exercises in arbitrariness.[321] Misha and Pavlasek argue that there are neither functional nor physical (spatial) bases for a boundary. Nevertheless, they suggest that "if a boundary is to be drawn, it should be based on human experience and desire, with an acceptance that such a boundary would be arbitrary."[322]

Hosenball and Hofgard pointed out that "no country or writer in the space field has identified any problem that would be resolved solely through the establishment of a boundary between air space and outer space."[323] They discounted the Bogotá Declaration as a genuine conflict on grounds that it had no basis in scientific fact or international law.[324] In their opinion, the large number of different proposals for a boundary virtually assures that states will not reach universal agreement on the issue. They conceded, however, that a boundary might one day be necessary, and that the advent of spaceplanes may be a catalyst in that regard. Nevertheless, they believed that it is premature to establish a boundary in the absence of a clear need for one.[325]

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[320] U.N. Doc. A/AC.105/C.2/SR.316, *supra* note 319, at 2.

[321] *See, e.g.*, Mishra, *supra* note 289, at 413; American Bar Foundation, *supra* note 24, at 46.

[322] Mishra, *supra* note 289, at 412, 413.

[323] S. N. Hosenball and J. S. Hofgard, "Delimitation of Air Space and Outer Space: Is a Boundary Needed Now," 57 *U. Colo. L. Rev.* 885, 892 (1986).

[324] *Id.*

[325] *Id.*

Professors McDougal, Lasswell, and Vlasic, writing in 1963, stated that they "do not favor the attempted establishment of any boundaries in superincumbent regions unless it can be demonstrated that such boundaries promote inclusive interest."[326] They recommended, however, that if an arbitrary boundary were to be established, then

> the line separating the region of a comprehensive, exclusive competence from that of inclusive competence be drawn as low as states can be persuaded to agree. Such a temporary upper boundary could be set high enough to provide protection for traditional airspace uses, as long as this protection is generally demanded. The closer to the surface of the earth such a boundary could be fixed the greater of course would be the protection of the common interest in expanding inclusive use.[327]

It should be noted that few states, jurists, or scientists seem to be willing to state unequivocally that a boundary is unnecessary. As illustrated above, proposals for possible boundaries tend to follow statements objecting to the need for a boundary. Even staunch boundary opponents like the United States concede that one day a boundary may be necessary.[328]

In some of its recent reports to the U.N. General Assembly, COPUOS has summarized the arguments of boundary opponents as follows:

> [Some] delegations reiterated the view that the need for such a definition or delimitation had not yet been established and that attempts to establish prematurely a boundary between airspace and outer space might complicate and impede progress in the peaceful exploration and use of outer space.[329]

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[326] McDougal, *supra* note 228, at 359.

[327] *Id.* at 356.

[328] For example, the U.S. has said, "[s]uch a boundary might conceivably be needed one day, but it did not seem. . . so urgent a matter that it must be attended to without further delay." U.N. Doc. A/AC.105/C.2/SR.396, *supra* note 308, at 2.

[329] U.N. Doc. A/51/20, *supra* note 255, at para. 125; *see also* U.N. Doc. A/50/20, *supra* note 255 (paragraph 115 contains identical language); U.N. Doc. A/49/20, *supra* note 255 (paragraph 114 contains substantially similar language); U.N. COPUOS, Rep. to the U.N.G.A. (48th Session) U.N. GAOR Supp. No. 20, U.N. Doc. A/48/20 (1993) (paragraph 100 contains identical language).

Describing the arguments against a boundary in its 1996 report to COPUOS, the Legal Subcommittee stated that "[t]he view was expressed that there was no practical or legal need to pursue the debate on a delimitation of outer space."[330] The Subcommittee's 1997 report did not summarize the arguments against a boundary.

D. Chapter Summary

None of the spatial, functional, or other approaches to the boundary issue have gained widespread support among states. Nevertheless, there is apparently enough concern among states that the issue needs to be resolved that the boundary matter remains on the COPUOS agenda.[331] Indeed, it has been noted that all states, in principle, recognize the need to determine the applicability "of the two fundamentally different legal regimes governing airspace and outer space . . . . Opinions diverge however on the timing of laying the foundation of an accord."[332]

For consideration in connection with this issue is a questionnaire regarding hybrid "aerospace objects" circulated to member states of COPUOS. In August 1995, the U.N. Secretary-General requested that those states respond to the questionnaire because the answers received would shed great light on the thoughts of states regarding not only the legal regime(s) applicable to hybrid vehicles, but also would help focus the debate on the airspace/outer space boundary. The questionnaire on "aerospace objects" is discussed in detail in the next chapter.

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[330] U.N. Doc. A/AC.105/639, *supra* note 256, at para. 13.

[331] U.N. Doc. A/AC.105/674, *supra* note 257 (the item was scheduled to be on the agenda of the Legal Subcommittee's 1998 session).

[332] D. Goedhuis, "Some Observations on the Problem of the Definition and/or the Delimitation of Outer Space," II *Ann. Air & Sp. L.* 287, 307 (1977).

CHAPTER IV

Attempts to Define the Term 'Space Object'

Another aspect of the space law regime that escaped definition, which is of particular relevance to the spaceplane, is the term 'space object.' As mentioned in Chapter II, the definition of 'space object' in the 1972 Liability Convention and the 1974 Registration Convention leaves much to be desired. These instruments only say that the "term 'space object' includes component parts of a space object as well as its launch vehicle and parts thereof."[333] What 'space objects' *are* is left open.

Whether a clearer definition of 'space object'—a term broad enough to encompass 'spacecraft' and 'space vehicle,' and limited to man-made objects—is needed has been debated for almost as long as the boundary issue. Like the boundary issue, the existence of differing views among states has resulted in non-resolution of the 'space object' issue. The debate on the definition basically falls into three phases: early debates during the drafting of the space law treaties, debates during the years just before and after the advent of the U.S. Space Shuttle, and recent efforts to determine the legal regime applicable to hybrid space objects such as spaceplanes.

A. Debates Leading to Definition of 'Space Object' in the Space Law Regime

Although the 1967 Outer Space Treaty was completed before the other international space law agreements, the COPUOS Legal Subcommittee actually began drafting the Liability Convention—and the Rescue Agreement—before it began work on the Outer Space Treaty.[334] The subjects of these agreements were deemed more

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[333] Liability Convention, *supra* note 209, at Article I(d); Registration Convention, *supra* note 210, at Article I(b).

[334] *See* U.N. Doc. A/AC.105/6, *supra* note 217. At its first session in 1962, the Legal Subcommittee considered a Soviet proposal for a general "Declaration of the Basic Principles Governing the Activities of States Pertaining to the Exploration and Use of Outer Space" (U.N. COPUOS Legal Subcomm., Proposal of the USSR, U.N. Doc. A/AC.105/C.2/L.1, *reprinted in id.*). This proposal

pressing than elaboration of general principles of space law because the U.S. and USSR had already sent objects and astronauts into space.[335] Difficulty agreeing on various aspects of the Liability Convention and the Rescue Agreement caused the Subcommittee to postpone their completion in favor of finalizing the constitutional Outer Space Treaty.

One of the issues upon which states could not agree was whether to define in the Liability Convention the types of objects to which the treaty would apply.[336] At the 1962 session of the Legal Subcommittee, the United States proposed that COPUOS establish a working group to draft an agreement on liability for space vehicle accidents. The proposal suggested some principles that the agreement should include, such as:

> States or international organizations responsible for the launching of *space vehicles* should be liable internationally for personal injury, loss of life, or property damage caused thereby, whether such injury, loss, or damage occurs on land, on the sea, or in the air. . ..[337]

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eventually gave rise to the authoritative Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space. *See supra* notes 174-76 and accompanying text.

[335] U.N. COPUOS, Summary Record of the First Meeting of the Legal Subcomm. (28 May 1962) U.N. Doc. A/AC.105/C.2/SR.1, 21 Aug. 1962, at 6-7. Besides, states could refer to General Assembly Resolution 1721 (XVI) of December 1961, which contained general principles regarding space activities, and which was considered declarative of customary international law. U.N.G.A. Res. 1721, *supra* note 172.

[336] Although it concerns the return of space objects to the launching state, the Rescue Agreement will not be discussed further in this chapter because it does not appear that the matter of defining 'space objects' was an issue during the Legal Subcommittee's debates on the Agreement. However, Canada and Australia did submit a working paper recommending that the agreement define 'space object' as: "any object or any of its component parts which a Launching State has launched or attempted to launch into outer space." U.N. COPUOS Legal Subcomm., Working Paper of Australia and Canada, "Assistance to and Return of Astronauts and Space Objects," U.N. Doc. A/AC.105/C.2/L.20, 21 June 1967 (revised version). Nevertheless, the Rescue Agreement does not contain a definition of 'space object.'

[337] U.N. COPUOS Legal Subcomm., Proposal of the U.S., "Liability for Space Vehicle Accidents," U.N. Doc. A/AC.105/C.2/L.4, 4 June 1962 (emphasis added). Later versions of the American proposal changed the term 'space vehicle' to 'object' and then to 'space object.' *See* U.N. COPUOS Legal Subcomm., Proposal of the U.S., "Convention Concerning Liability for Damage Caused by the Launching of Objects Into Outer Space," U.N. Doc. A/AC.105/C.2/L.8, 9 Mar. 1964; U.N. COPUOS Legal Subcomm., Proposal of the U.S., "Convention Concerning Liability for Damage Caused by the Launching of Objects Into Outer Space," U.N. Doc. A/AC.105/C.2/L.19, 21 June 1967.

However, the proposal did not define 'space vehicle.' In the debates, the Swedish delegate stated that a clear understanding of the implications of the proposal required the definition of several terms. In particular, he thought it "necessary to define the meaning of the term 'space vehicles' whether by reference to the design or by reference to the destination of the devices."[338]

The absence of a definition of the objects to be covered concerned also Belgium. In its working paper, the Belgium delegation proposed, *inter alia,* that the treaty use the term 'space device'--a more general term than 'space vehicle'--and define it as "any device which is intended to move in space, remaining there by means other than the reaction of air."[339] The Belgian delegate explained that

> [i]f the Sub-Committee was to consider the problems of liability and assistance, it must first settle an elementary question—the sphere of application of space law. His delegation did not favour those theories which sought a demarcation between outer space and air space. It preferred to place the emphasis on the means employed—the idea of the spaceship—as the central element in the definition of space law. In its view, space law should be applicable in both atmospheric and outer space whenever the activities of space vehicles or the consequences of their activities were concerned. Hence, an internationally agreed legal definition of space vehicles should be included in any settlement of

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[338] U.N. COPUOS, Summary Record of the Eleventh Meeting of the Legal Subcomm. (14 June 1962) U.N. Doc. A/AC.105/C.2/SR.11, 21 Aug. 1962, at 2. He noted also that if the definition turned on the destination of the object, then a definition of 'space' would be necessary—an issue that the Subcommittee still had not settled.

[339] U.N. COPUOS Legal Subcomm., Working Paper of Belgium, U.N. Doc. A/AC.105/C.2/L.7, *reprinted in* U.N. COPUOS, Rep. of the Legal Subcomm. on the Work of its Second Session (16 Apr. - 3 May 1963) U.N. Doc. A/AC.105/12, 6 May 1963, Annex I, at 11. A third version of the proposal defined 'space device' as "any device intended to move in space and sustained there by means other than the reaction of air, as well as any constituent element of such device or of the equipment used for its launching or propulsion." U.N. COPUOS Legal Subcomm., Proposal of Belgium, "Proposal for a Convention on the Unification of Certain Rules Governing Liability for Damage Caused by Space Devices to Third Parties on the Surface of the Earth and to Aircraft in Flight," U.N. Doc. A/AC.105/C.2/L.7/Rev. 3, 26 June 1967. Belgium later requested that the term 'space device,' which it initially thought was the best description to use, be replaced by the term 'space object.' U.N. COPUOS, Summary Record of the 106th Meeting of the Legal Subcomm. (25 June 1968) U.N. Doc. A/AC.105/C.2/SR.106, 25 June 1968, at 57 [hereinafter U.N. Doc. A/AC.105/C.2/SR.106].

specific problems, such as liability or assistance. . ..[340]

Other states believing that the Liability Convention should contain a definition of 'space object' included Mexico,[341] Iran,[342] Czechoslovakia,[343] Poland,[344] Australia,[345] Argentina,[346] and India.[347] Hungary submitted a draft liability treaty as an alternative to the American proposal which included the following definition of 'space object:'

> [f]or the purposes of this Agreement 'Space Object' means space ships, satellites, orbital laboratories, containers and any other devices designed for movement in outer space and sustained there otherwise than by the reaction of air, as well as the means of launching of such objects.[348]

When the Legal Subcommittee resumed debate on the Liability Convention after putting it aside to focus on the Outer Space Treaty, the definition of 'space object' received new attention. In addition to the earlier proposals, the Subcommittee

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[340] U.N. COPUOS, Summary Record of the Nineteenth Meeting of the Legal Subcomm. (19 Apr. 1963) U.N. Doc. A/AC.105/C.2/SR.19, 27 June 1963, at 4.

[341] U.N. COPUOS, Summary Record of the 33rd Meeting of the Legal Subcomm. (13 Mar. 1964) U.N. Doc. A/AC.105/C.2/SR.33, 13 Mar. 1964, at 65.

[342] U.N. COPUOS, Summary Record of the 93rd Meeting of the Legal Subcomm. (7 June 1968) U.N. Doc. A/AC.105/C.2/SR.93, 7 June 1968, at 37 [hereinafter U.N. Doc. A/AC.105/C.2/SR.93].

[343] U.N. Doc. A/AC.105/C.2/SR.106, *supra* note 339, at 57.

[344] *Id.* at 58.

[345] *Id.* at 60.

[346] *Id.* at 61.

[347] U.N. COPUOS, Rep. of the Legal Subcomm. on the Work of the Second Part of its Third Session (5 - 23 Oct. 1964) U.N. Doc. A/AC.105/21, 23 Oct. 1964, Annex II, at 28. India suggested that 'space object' be defined as a "spaceship, satellite, or any other vehicle, device or object howsoever designated, designed for movement in outer space and intended to sustain there otherwise than by the reaction of air and includes its component parts and apparatus or equipment used in the launching." *Id.*

[348] U.N. COPUOS Legal Subcomm., Proposal of Hungary, "Agreement Concerning Liability for Damage Caused by the Launching of Objects Into Outer Space," U.N. Doc. A/AC.105/C.2/L.10, 16 Mar. 1964, at 2.

now dealt with additional suggestions for definitions. For example, Argentina[349] and Italy[350] submitted definitions for consideration.

During these early debates, the U.S. and USSR remained virtually silent. Sweden, whose delegate was one of the first to mention the possible need for a definition, later was one of the first to say that it was not absolutely necessary that a definition be included. He pointed out that the Outer Space Treaty referred to 'objects' in outer space and to 'space objects,' yet it did not define those terms.[351] He thereby implied that the Liability Convention presented no special circumstances calling for a definition.

The various proposals for a definition seemed to fall on deaf ears (except for the ears of the proponents and their supporters) until the Soviet Union stated in 1968 that while some of the provisions of the draft proposals for the Liability Convention should not be further defined, they believed that it was possible to come to agreement on a definition for space objects.[352] The Canadian delegate stated that his delegation

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[349] U.N. COPUOS Legal Subcomm., Proposal of Argentina, "Agreement on Liability for Damage Caused by Space Vehicles," U.N. Doc. A/AC.105/C.2/L.22, 23 June 1967. Argentina proposed that the treaty include a definition of 'space vehicle' as "any device launched by man, exclusively for peaceful purposes, for the exploration or use of outer space, including the Moon and other celestial bodies, as well as the equipment used for launching and propulsion and any parts detached therefrom." *Id.*

[350] U.N. COPUOS Legal Subcomm., Working Paper of Italy, "Draft Convention Concerning Liability for Damage Caused by the Launching of Objects into Outer Space," U.N. Doc. A/AC.105/C.2/L.40, *reprinted in* U.N. COPUOS Legal Subcomm., Addendum to Comparative Table—Italy: Proposal, U.N. Doc. A/AC.105/C.2/W.2/Rev. 4/Add. 3, 17 June 1968. The Italian proposal stated that

> space object means any man-made object designed to reach outer space and to move there (either) naturally or by means of radioelectric signals or the control exercised by pilots on board; . . . . For the purposes of this Convention, the component parts of space objects that became detached or are made to detach during transit, and objects thrown or launched from space objects, shall be deemed to be space objects.

Id.

[351] U.N. Doc. A/AC.105/C.2/SR.93, *supra* note 342.

[352] U.N. COPUOS, Summary Record of the 104th Meeting of the Legal Subcomm. (21 June 1968) U.N. Doc. A/AC.105/C.2/SR.104, 21 June 1968, at 38.

"would be willing to take up the . . . definition if a proposal to that effect was submitted to the Subcommittee."[353]

Now that one of the superpowers had spoken in favor of definition, the United States and the United Kingdom expressed opposition to the definitions that had been proposed. The British delegate stated that if there was to be a definition of 'space object,' then it should be a simple one.[354] She was concerned, however, that the proposals then pending before the Subcommittee were scientifically inaccurate. For example, she pointed out that it was incorrect to define space objects as being sustained in space 'by means other than the reaction of air.'[355] The U.S. did not think that a definition was necessary, and concurred with the U.K. that the pending proposals were factually and technically incorrect in relying on the lack of reaction of the air because "some bodies at extraordinarily high altitudes derived a measure of support from aerodynamic lift."[356]

France expressed doubts about the possibility of developing an acceptable definition. Its delegate pointed out that

> all the proposals so far submitted referred to outer space, a term which it had not yet been possible to define. It might be that attempts to define 'space object' would face the same difficulties as had been encountered in the case of 'outer space.'[357]

Concurring with France, Australia proposed that, in order to avoid technical inaccuracies and references to outer space, the definition should simply state that "'space object' includes component parts and equipment carried on the space object, a

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[353] *Id.* at 39. Canada later proposed the following: "'space object' means any device for use in outer space as well as all equipment used for its launching and propulsion and any component part thereof." U.N. Doc. A/AC.105/C.2/SR.106, *supra* note 339, at 59.

[354] U.N. Doc. A/AC.105/C.2/SR.106, *supra* note 339, at 56 (it also should include component parts).

[355] *Id.*

[356] *Id.*

[357] *Id.* at 60.

launch vehicle, and any component parts of a launch vehicle."[358] The delegate explained that no further details were necessary because it could be assumed that the term 'space object' "had a reasonably understood and accepted meaning."[359]

In light of the varying proposals and differing views as to whether a definition was needed, the Subcommittee referred the matter to a working group. The working group decided that the Liability Convention should contain a definition and drafted language for it that was quite similar to that proposed by Australia: "the term 'space object' includes component parts of the space object as well as its launch vehicle and parts thereof."[360] This is essentially the version in the 1972 Liability Convention.

Not all member states of COPUOS were completely satisfied with that definition. For example, when the Subcommittee turned its attention to drafting the Registration Convention, and it was proposed that this Convention include the same definition of 'space object' as contained in the Liability Convention, the Italian delegate pointed out that there might be difficulty determining what items needed to be registered in the absence of a clear definition of 'space object.'[361] Nevertheless, the debate regarding the definition of 'space object' for the Registration Convention did not rise to the level of that for the Liability Convention. In essence, it was considered a controversial issue better left alone.[362]

The question of defining 'space object' attracted the attention of many jurists. For example, Dr. Sztucki, who was a member of the Polish delegation at the Legal

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[358] *Id.* at 61.

[359] *Id.* at 60.

[360] U.N. COPUOS, Rep. of the Legal Subcomm. on the Work of its Eighth Session (9 June -4 July 1969) U.N. Doc. A/AC.105/58, 4 July 1969, at 8.

[361] U.N. COPUOS, Summary Record of the 190th Meeting of the Legal Subcomm. (4 May 1972) U.N. Doc. A/AC.105/C.2/SR.190, 4 May 1972, at 43.

[362] For example, the Canadian delegate stated that its proposed draft of Article I for the Registration Convention did not contain a different definition of space object because "that was still a controversial question." U.N. COPUOS, Summary Record of the 197th Meeting of the Legal Subcomm. (2 Apr. 1973) U.N Doc. A/AC.105/C.2/SR.197, 2 Apr. 1973, at 52.

Subcommittee's first session in 1962, pointed out in 1966 that to question whether a definition for 'space object' is needed is, in essence, to ask what is an object's legal status.[363] Indeed, most of the early legal writings on the matter of space objects focused on what the legal status of certain types of objects would be, rather than on directly addressing whether the term 'space object' should be defined.[364] In light of the existence of varying criteria and proposals defining 'space objects,' Dr. Sztucki predicted that opinions may differ as to whether the term would apply to "craft . . . [able] to fly both as orbiting objects . . . and as conventional airocraft [sic]."[365] Nevertheless, because space technology was continually evolving, he believed it was premature to try to systematically categorize space objects in an attempt to clarify their legal status.[366]

Writing in 1968, Professor Fawcett stated that when trying to categorize objects as spacecraft—which he used as a "general term to describe any object, whether it is a vehicle or not, which goes into Earth orbit or beyond"[367]—one should look at the function or purpose of the object. For example, he did not consider the American X-15 vehicle to be a spacecraft, since it was not intended to go into orbit. However, if the vehicle did "develop the capacity to leave the ground as an aircraft and

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[363] J. Sztucki, "Legal Status of Space Objects," *Proceedings of the Ninth Colloquium on the Law of Outer Space* (California: U.C.-Davis School of Law, 1967) 108, 108 [hereinafter Sztucki].

[364] *See, e.g.*, J. J. Lopez-Gutierrez, "Legal Status of Space Vehicles—Nationality (Unilateral Decisions) v. Internationality (Multinational Operation)," *Proceedings of the Ninth Colloquium on the Law of Outer Space* (California: U.C.-Davis School of Law, 1967) 132; M. Tripodi, "The Juridical Regime of Craft and Space Installations," *Proceedings of the Ninth Colloquium on the Law of Outer Space* (California: U.C.-Davis School of Law, 1967) 143; J. Sztucki, "Some Preliminary Problems of the Legal Status of Space Objects," *Proceedings of the Eighth Colloquium on the Law of Outer Space* (Norman, OK: The Univ. of Oklahoma Research Institute, 1966) 444 (Dr. Sztucki also analyzed the various definitions of 'space object,' 'spacecraft,' and 'space vehicle' that had been proposed by states and international organizations.).

[365] Sztucki, *supra* note 363, at 109.

[366] *Id.*

[367] Fawcett, *supra* note 165, at 2.

go into Earth orbit as a satellite, the same functional test of the mode of flight must be applied."[368]

Noting in 1971 that neither the Outer Space Treaty nor the Rescue Agreement defined 'space object' or 'spacecraft,' the International Law Association believed that a definition of either or both of those terms was necessary to provide "an accurate determination of the scope of State jurisdiction."[369] The Association established a working group to study the "Legal Status of Spacecraft," including the definitions that had been proposed for the term 'space object.'[370]

Professor Matte, like the French delegate to the COPUOS Legal Subcommittee who expressed doubts that a clear definition would be possible, summed up the result of the debates on the 'space object' definition by stating that "the main impediment in providing a precise definition of the space object remains directly linked to the fact that 'all proposals to this effect were based on a concept of outer space, which . . . has not . . . been defined.'"[371]

B. Resumption of the 'Space Object' Debate Caused by the Advent of the U.S. Space Shuttle

As indicated in prior chapters, the idea of developing hybrid space vehicles that could travel in airspace and outer space had been around long before the first space law treaty was concluded. The idea had not been realized, however, by the time the 1972 Liability Convention and the 1974 Registration Convention entered into force. Up to

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[368] *Id.*

[369] I.A. Csabafi, *The Concept of State Jurisdiction in International Space Law* (The Hague: Martinus Nijhoff, 1971) 11.

[370] *Id.* at 10-14.

[371] G.P. Zhoukov, "Definition and Classification of the Space Object: An Important Issue in International Space Law," *Liber Amicorum Honouring Nicolas Mateesco Matte: Beyond Boundaries* (Canada: De Daro Publishing, 1989) 359, 360 (paraphrasing and quoting Professor Matte) [hereinafter Zhoukov].

that point, therefore, there was little reason to vigorously challenge the space object definition in those instruments. But in the years just before and after the first U.S. Space Shuttle flight in 1981, numerous discussions concerning the shuttle's legal status took place. Key operational features distinguishing the shuttle from previous spacecraft are its ability to return to earth intact and its reusability.[372] These unique characteristics brought new perspective to the definitional questions remaining in the space law regime. On the one hand, the shuttle returns to earth as a vehicle that fits the definition of 'aircraft' contained in Annex 7 to the 1944 Chicago Convention. On the other hand, the definition of 'space object' in the space law treaties did little to clarify the status of this vehicle. As outlined in Chapter II, and as so eloquently put by Professor Kopal, the air and space law regimes are "two different legal orders . . . [that] substantially differ both in their essential principles and in their specific rules."[373] The space shuttle was bound to generate questions regarding which regime should apply to it.

There were those who argued that the shuttle was subject to both the air law and space law regimes.[374] This school of thought believed that the shuttle should be considered a space object, and therefore subject to space law, from the moment of launch until it began its descent from orbit. But that when the shuttle re-entered airspace, it became an aircraft, and therefore subject to air law. This view is often referred to as the 'territorial' or 'spatial' approach to the question. This approach is criticized because its reliance on two different legal regimes can cause confusion.[375]

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[372] *See* F. Moss, "The Space Shuttle and the Law of Outer Space," *Proceedings of the Nineteenth Colloquium on the Law of Outer Space* (California: U.C.-Davis School of Law, 1977) 175 [hereinafter Moss]. Senator Moss stated that the shuttle would have to be registered as a space object because it would be launched into orbit. *Id.* at 180.

[373] V. Kopal, "Some Considerations on the Legal Status of Aerospace Systems," 22 *J. Sp. L.* 57, 61 (1994) [hereinafter Kopal].

[374] *See generally id.* at 68; Zhoukov, *supra* note 371, at 361.

[375] *See, e.g.*, H.L. van Traa-Engelman, "International Legal Requirements as a Basis for Juridically Feasible Space Transportation," *Proceedings of the Twenty-fourth Colloquium on the Law of Outer Space* (New York: AIAA, 1982) 135, 141 [hereinafter, "Legal Requirements"]. *But see* S. Gorove,

Another criticism, of course, is that it brings up that old boundary debate—at what point is the vehicle in outer space, and at what point is it in airspace?

Others argued that only the space law regime should apply to the shuttle.[376] Proponents of this view often point to the Rescue Agreement as evidence that there is consensus that space objects retain their nature as 'space objects' upon return to earth, because that treaty requires that *space objects* found in the territory of a foreign state be returned to the launching state.[377] Another reason advanced for only applying space law to the shuttle is that the sole purpose of the shuttle is to conduct activities in outer space, not in airspace. This position is usually referred to as the 'functional' approach.[378] The functional approach is criticized because it does not appear to take into consideration the attempts to develop hybrid propulsion systems that would enable vehicles to operate in airspace as well as in outer space.[379] It is also believed that confusion could result when trying to apply different legal regimes to objects--that is, a space object and an aircraft--flying at the same altitude.[380]

"Legal and Policy Issues of the Aerospace Plane," 16 *J. Sp. L.* 147 (1988). Professor Gorove said this approach may seem inconsistent and complicated, but considering the hybrid nature of spaceplanes, it just might be the proper solution. He said that whether both legal regimes apply will have to be a policy choice of states. "What is important is that the policy choice should be weighed after a careful evaluation of the attendant factual circumstances of the case at hand." *Id.* at 154-55.

[376] *See, e.g.*, G. Gál, "The Space Shuttle Between Air Law and Space Law," *Proceedings of the Twenty-fourth Colloquium on the Law of Outer Space* (New York: AIAA, 1982) 103, 104; *see also Space Law, supra* note 186, at 209 (saying that it "has been pointed out that the definition of 'space object' in the 1972 Liability Convention does not 'exclude flight instrumentalities that are so designed as to be sustained by the reactions of air while passing through the atmosphere prior or subsequent to passage through outer space'" (quoting Foster, "The Convention on International Liability for Damage Caused by Space Objects," 10 *Canadian Y.B. Int'l L.* 137, 159, n.73 (1972)).

[377] Rescue Agreement, *supra* note 213, at Article 5.

[378] *See, e.g.*, Kopal, *supra* note 373, at 69; Zhoukov, *supra* note 371, at 361 (describing the functional approach as also encompassing reference to the propulsion system used by the object); *Recueil des Cours*, *supra* note 162, at 399-400.

[379] Zhoukov, *supra* note 371, at 361.

[380] "Legal Requirements," *supra* note 375, at 141.

Still another position holds a new legal regime should be developed to cover hybrid vehicles such as the space shuttle.[381] Although several jurists have suggested this approach, none has presented a detailed proposal for such a regime. A closely related view is that vehicles like the shuttle be placed in a category separate from that of aircraft and other spacecraft—namely into a category for 'aerospace' vehicles. Mr. Sloup was a proponent of this approach.[382] Under this view, the vehicle would be treated as an aircraft or as a spacecraft depending on the circumstances.[383]

Discussions about the status of the space shuttle practically ceased after the U.S. Federal Aviation Administration (FAA) notified NASA in 1977 that the FAA did not consider the shuttle to be an aircraft.[384] The FAA pointed out that the shuttle's main purpose was to conduct activities in space and that its presence in airspace was merely incidental to that purpose. In addition, they noted that the shuttle had little

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[381] *See, e.g.*, "The aerospace plane," *supra* note 303, at 41; B. Stockfish, "Space Transportation and the Need for a New International Legal and Institutional Regime," XVII-II *Ann. Air & Sp. L.* 323 (1992); P.P.C. Haanappel, "The Aerospace Plane: Analogies with Other Modes of Transportation," *Proceedings of the Thirty-second Colloquium on the Law of Outer Space* (Washington, D.C.: AIAA, 1990) 341 [hereinafter Haanappel]. *Cf.* G.P. Sloup, "The Relationship of Air Law and Space Law—A View From the Space Shuttle, Including its Internal and External Environments," *Proceedings of the Nineteenth Colloquium on the Law of Outer Space* (California: U.C.-Davis School of Law, 1977) 202, 205 (predicting the space shuttle could result in the development of a new area of law called 'aerospace law,' which would be a fusion of certain aspects of the air and space law regimes); *accord* Wassenbergh, *supra* note 200, at 21; *contra* Kopal, *supra* note 373, at 73 ("it is hard to believe that both legal regimes will converge in one aerospace regime governed by a single system of aerospace law in a foreseeable future").

[382] G.P. Sloup, "The 'Aerospace Vehicle' As a Legal Concept—On Final Approach?" VIII *Ann. Air & Sp. L.* 433 (1983) [hereinafter Sloup]. Mr. Sloup based his suggestion on the definition of 'aerospace vehicle' contained in the 1965 NASA dictionary: "[a] vehicle capable of flight within and outside the sensible atmosphere." *Id.* at 435. *See also* R.D. Margo and R. Lenhard, "Space Shuttle Identity Crisis," *excerpted in Space Law and Institutions: Documents and Materials*, I.A. Vlasic, ed. (Montreal: McGill Univ., 1997) 212.

[383] Sloup, *supra* note 382, at 436.

[384] G.J. Mossinghoff and G.P. Sloup, "Legal Issues Inherent in Space Shuttle Operations," 6 *J. Sp. L.* 47, 65-66 (1978) (excerpting a letter from the FAA Chief Counsel to the NASA General Counsel, dated 11 March 1977) [hereinafter Mossinghoff]. *See also* Moss, *supra* note 372, at 180 ("[L]ike other spacecraft, the Shuttle must be registered under the Registration Convention as a 'space object' because it will be launched into earth orbit. . . . The Shuttle's registration as a space object is consistent with its purposes, developmental history and the [National Aeronautics and Space Act of 1958].").

flexibility to maneuver in airspace, and that this provided an additional reason for not categorizing it as an aircraft.[385] Therefore, the U.S. has always considered the space shuttle to be, and has registered it as, a 'space object.'[386]

Unfortunately, national definitions are not binding internationally. Thus, it has not yet been possible to discount assertions that the space shuttle, and other hybrid vehicles, are subject to both the space and air law regimes.[387] Nevertheless, states have had little reason to question the U.S.'s conclusion that the shuttle is a space object at all times. The U.S. has generally been able to return the shuttle by flying it over the high seas to coastal landing sites in Florida or California. In case the shuttle needs to land elsewhere for emergency purposes, the U.S. has entered into bilateral agreements with several strategically located countries to assure shuttle landing privileges in their territories.[388] Thus far, the shuttle has generally avoided unauthorized flights through foreign airspace.[389]

However, the question of a more clear definition of 'space object' did not disappear. For example, the Italian delegate to the COPUOS Legal Subcommittee suggested in 1983 that the Subcommittee consider clarifying the definition of 'outer space objects' and 'outer space activities,' primarily as a means of addressing the airspace/outer space boundary issue and the questions surrounding the status of the

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[385] Mossinghoff, *supra* note 384, at 66. The FAA noted that gliders, which fall within most definitions of aircraft, also have little flexibility in airspace; but the shuttle's space function precluded placing it in the same category.

[386] *See* Moss, *supra* note 372, at 180. The U.S. delegate to the COPUOS Legal Subcommittee stated in 1992 that "for the purposes of the 1967 Outer Space Treaty, a space shuttle [is] treated as a space object." U.N. Doc. A/AC.105/C.2/SR.559, *supra* note 247, at 6. Nevertheless, coordination with air traffic officials occurs so that collisions with aircraft are avoided while the shuttle is in airspace.

[387] *See* Sloup, *supra* note 382, at 436.

[388] *See supra* note 36.

[389] *But see supra* notes 197-98 and accompanying text (The U.S. Space Shuttle Atlantis crossed over Soviet territory during one of its return flights in 1990.).

geostationary orbit.[390] This proposal did not gain much support. Others who expressed the view that there was still a need to define 'space object' so that states would clearly know the possible consequences of their activities include Professor Gorove,[391] Mr. Lukin,[392] Mr. Hintz,[393] Professor Cheng,[394] and Professor Wassenbergh.[395]

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[390] U.N. COPUOS, Summary Record of the 395th Meeting of the Legal Subcomm. (6 Apr. 1983) U.N. Doc. A/AC.105/C.2/SR.395, 12 Apr. 1983, at 2.

[391] S. Gorove, "Major Definitional Issues in the Space Agreements," *Proceedings of the Thirty-fifth Colloquium on the Law of Outer Space* (Washington, D.C.: AIAA, 1993), 76 (He pointed out that

> [a]n attempt at clarification may point to an authoritative pronouncement that may provide guidance in reflecting the choices made by international policy makers as to whether damage caused by a particular object should or should not entail international liability under the Liability Convention and whether such an object should or should not be returned to the launching authority as required by the Astronauts Agreement.

Id. at 77. *See also*, S. Gorove, "Toward a Clarification of the Term 'Space Object'—An International Legal and Policy Imperative?" 21 *J. Sp. L.* 11, 25 (1993).

[392] P.J. Lukin, "On the Definition of Space Objects," *Proceedings of the Nineteenth Colloquium on the Law of Outer Space* (California: U.C-Davis School of Law, 1977) 312, 315 (suggesting the following definition: "[t]he space object is an object belonging to one or many states or non-governmental entities, launched into outer space or on a celestial body for collecting and transmitting information, for transportation and manufacturing processes, and controlled by the ground centre").

[393] M. Hintz, "Legal Regime for the Aerospace-Plane—Spaceplane Projects and the Space Object Definition," *Proceedings of the Thirty-third Colloquium on the Law of Outer Space* (Washington, D.C.: AIAA, 1991) 210, 211 [hereinafter Hintz] (suggesting as a definition: "[s]pace objects are all objects which are launched into outer space for the purpose of outer space use or exploration or are intended to do so").

[394] B. Cheng, "'Space Objects,' 'Astronauts' and Related Expressions," *Proceedings of the Thirty-fourth Colloquium on the Law of Outer Space* (Washington, D.C.: AIAA, 1992) 17, 20 (stating that 'space object' could be defined as "any object that is being launched, or has been launched, into those heights [*i.e.*, 96 km] and beyond, whether or not into earth orbit").

[395] H. Wassenbergh, "An International Institutional Framework for Private Space Activities," XXII-I *Ann. Air & Sp. L.* 529, 532 (1997) (suggesting that 'space object' be defined as "an object which is launched or is meant to be launched into outer space for the purpose of exploration or use (including the exploitation of natural space resources and space transportation) in outer space").

C. Attempt to Resolve the Boundary and 'Space Object' Debates By Defining 'Aerospace Objects'

1. The Current COPUOS Debates

The debate over the legal status of space objects, or whether there is even a need to engage in such discussions, continues. Instead of trying to change the definitions contained in the Liability and Registration Conventions, however, the Legal Subcommittee is approaching the matter from another direction. It has tied the question to the airspace/outer space boundary issue. The focus now is on the legal regime that should be applicable to spaceplanes and other types of 'aerospace objects.'

It should be noted that some states have believed for a long time that hybrid vehicles might warrant special consideration.[396] Therefore, it comes as no surprise that in the mid- to late 1980s, when so many spaceplane projects were in development, and the U.S. Space Shuttle was a fixture in the space arena, the topic came up again while the COPUOS Legal Subcommittee was discussing the question of a boundary between airspace and outer space. For example, in 1989, some delegates suggested that

> the rapid progress of space technology, including employment of reusable spacecraft which return to the Earth in aircraft mode, and the anticipated development in some countries of airspace planes which would be able to operate both in outer space and in airspace, was an additional argument in favour of establishing an agreed boundary between airspace and outer space.[397]

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[396] *See, e.g.*, U.N. Doc. A/AC.105/C.2/SR.81, *supra* note 222, at 4 (The British delegate to the COPUOS Legal Subcommittee, said "it might be difficult to maintain that one regime should apply to aircraft. . . and that another should apply to spacecraft, when it was known that hybrid craft existed which used aerodynamic lift at lower altitudes and then went into orbit with the aid of other devices.").

[397] U.N. COPUOS, Rep. of the Legal Subcomm. on the Work of its 28th Session (20 Mar. - 7 Apr. 1989) U.N. Doc. A/AC.105/430, 26 Apr. 1989, at 29. The same points were made in 1990 and 1991, to which other delegates responded that "the future advent of aerospace vehicles did not adequately justify the delimitation of airspace from outer space." U.N. COPUOS, Rep. of the Legal Subcomm. on the Work of its 29th Session (2 - 20 Apr. 1989 (sic)) U.N. Doc. A.AC.105/457, 2 May 1990, at 26 [hereinafter U.N. Doc. A.AC.105/457]; U.N. COPUOS, Rep. of the Legal Subcomm. on the Work of its 30th Session (25 Mar. - 12 Apr. 1991) U.N. Doc. A/AC.105/484, 17 Apr. 1991, at 22, 23 [hereinafter U.N. Doc. A/AC.105/484].

At the 1990 and 1991 sessions of the Legal Subcommittee, some delegates pressed that body to discuss the legal problems that could accompany the advent of spaceplanes,[398] again connecting this to the boundary issue. Indirectly, the 'space object' issue was implicated since some believed that the lack of a clear definition precluded the conclusion that spaceplanes would only be subject to space law.

The Russian Federation attempted to get discussions started in 1992 by submitting a working paper titled 'Questions Concerning the Legal Regime for Aerospace Objects.'[399] The paper was presented under the Subcommittee's agenda item on the 'definition and delimitation of outer space and the status of the geostationary orbit.' Noting that the legal regime applicable to objects differed depending on their location, the Russian Federation stated that it hoped the working paper would result in agreement as to the legal regime(s) applicable to aerospace objects. The term 'aerospace object,' for purposes of the working paper, meant

> an object which is launched into outer space and which is capable at some stage in its flight of using its aerodynamic properties to remain in airspace for a relatively long period. This may occur on launch or return from orbit, or during flight, when the aerospace object temporarily enters airspace and then returns to outer space orbit.[400]

The paper suggested several questions to be considered in determining the applicable legal regime. The questions included whether the aerospace object could be considered an aircraft during its flight through airspace, whether the object's takeoff phase should be subject to a different legal regime than its landing phase, whether a new legal regime is necessary, and whether the space law registration rules need to be changed in light of

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[398] U.N. Doc. A/AC.105/457, *supra* note 397, at 26; U.N. Doc. A/AC.105/484, *supra* note 397, at 22, 23.

[399] U.N. COPUOS Legal Subcomm., Working Paper of the Russian Federation, "Questions Concerning the Legal Regime for Aerospace Objects," U.N. Doc. A/AC.105/C.2/L.189, 30 Mar. 1992, *reprinted in* U.N. COPUOS, Rep. of the Legal Subcomm. on the Work of its 31st Session (23 Mar. -10 Apr. 1992) U.N. Doc. A/AC.105/514, 20 Apr. 1992, at 48-49.

[400] *Id.* at 48.

aerospace objects.[401] It should be noted that the Russian Federation once again expressed its belief that a right of innocent passage has already been established by state practice; their question in this regard, therefore, was whether prior notification of such flights through foreign airspace should be a requirement.[402]

Delegates that supported discussion of the Russian paper included those from Argentina,[403] Indonesia,[404] France,[405] and India.[406] The American delegate said that "it would be better not to tamper with the existing legal regime for outer space, which has produced such beneficial results over the years."[407] He also pointed out, in response to a question from the Czechoslovakian delegate, that the U.S. treats the space shuttle as a space object for purposes of the 1967 Outer Space Treaty.[408] The British delegate, however, stated that although his country did not believe that a boundary between airspace and outer space was necessary, the Russian working paper raised some interesting questions.[409] He nevertheless believed that as regards aerospace objects, the only need was that their operators secure coordination with relevant air traffic control systems to avoid collision.[410]

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401 *Id.* at 49.

402 *Id.*

403 U.N. Doc. A/AC.105/C.2/SR.558, *supra* note 252, at 2.

404 U.N. Doc. A/AC.105/C.2/SR.559, *supra* note 247, at 2.

405 *Id.* at 4.

406 *Id.*

407 *Id.*

408 *Id.*

409 U.N. Doc. A/AC.105/C.2/SR.560, *supra* note 250, at 2.

410 *Id.*

The following year, a Legal Subcommittee working group began drafting a questionnaire based on the Russian working paper.[411] The questionnaire was finalized and issued to COPUOS member states in 1995 with a request from the U.N. Secretary-General that states provide their responses to the Secretariat.[412] A primary purpose of the questionnaire is to gather information that could aid states in their discussion of the boundary issue.[413] There are nine questions covering such matters as how aerospace objects should be defined, the legal regime(s) applicable to such objects, whether a new legal regime should be developed for them, whether there is a right to innocent passage through foreign airspace for returning aerospace objects, and whether these objects need to be registered under the Registration Convention.[414] As of this writing, only a handful of states have replied.[415]

The questions and a brief summary of the replies are in the next section of this chapter. The replies reveal the differences of opinion that still exist on the issues of a boundary between airspace and outer space, the legal regime of spaceplanes, and whether there is or should be a right of innocent passage—even if just for spaceplanes.

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[411] U.N. COPUOS Legal Subcomm., Informal Paper by Working Group Chairman, "Draft Questionnaire Concerning Aerospace Objects," U.N. Doc. A/AC.105/C.2/1993/CRP.1, 29 Mar. 1993, *reprinted in Space Law and Institutions: Documents and Materials*, I.A. Vlasic, ed. (Montreal: McGill Univ., 1997) 170.

[412] U.N. Doc. A/AC.105/635, *supra* note 197.

[413] *Id.* at Note by the Secretariat; *see also* "Legal and Policy Issues," *supra* note 186, at 412.

[414] The questionnaire is reprinted in U.N. Doc. A/AC.105/635, *supra* note 197.

[415] As of 25 June 1998, the COPUOS Internet Home Page only contained responses from the Czech Republic, Germany, Iraq, Italy, Mexico, Pakistan, the Philippines, the Republic of Korea, and the Russian Federation. The United Kingdom of Great Britain and Northern Ireland notified the Secretariat that:

> [t]he Government of the United Kingdom acknowledges the importance of the subject and the possible future implications of considering legal issues in this area of Aerospace Objects, but regrets that it is unable to provide an agreed response to the questionnaire at present. The matter will be kept under review and a response will be forwarded to the Committee on the Peaceful Uses of Outer Space in due course.

U.N. Doc. A/AC.105/635, *supra* note 197; *see also* http://www.un.or.at/OOSA/aero/aero10.html (accessed: 11 May 1998 and 25 June 1998).

Among those states that have not responded to the questionnaire are those which do not believe that any of these issues are ripe for discussion. In its 1996 report, the Legal Subcommittee summarized the arguments of these states as follows:

> The view was expressed that there was no reason why replies to the questionnaire were necessary at the present time; that, in its current form, the questionnaire reflected the contradictions and uncertainties of the previous debate on the subject; that the questions were presented in an ambiguous manner . . . that did not serve to clarify the issue; that the questionnaire in its present form could revive the unproductive debate on the direct and topographical or indirect and functional approach to the definition and delimitation of outer space; and that such an examination of legal issues with regard to aerospace objects inevitably questioned the foundation of the law of outer space. . . . The view was expressed that there was no practical or legal need to pursue the debate on a delimitation of outer space and that the questionnaire on aerospace objects in its present form was unnecessary, premature and would raise further contentious issues and was unlikely to bring about any consensus results. In the view of that delegation the debate should therefore not be continued.[416]

The 1997 Legal Subcommittee report indicated that opponents raised the same objections to the questionnaire during that year's session.[417]

For the American Institute of Aeronautics and Astronautics' 1997 Colloquium on the Law of Outer Space, Professor Gorove analyzed the legal and policy issues surrounding the term 'aerospace object.'[418] While he did not object to the use of the term, he did advise that the COPUOS questionnaire's proposed definition of 'aerospace object' be clarified and refined to expressly include or exclude earth-to-earth types of spaceplanes.[419]

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[416] U.N. Doc. A/AC.105/639, *supra* note 256, paras. 12, 13.

[417] U.N. Doc. A/AC.105/674, *supra* note 257.

[418] "Legal and Policy Issues," *supra* note 186.

[419] *Id.* at 411.

2. *The Aerospace Object Questionnaire and Replies of States*

Following is a brief summary of the replies provided by the nine states that responded to the COPUOS questionnaire as of this writing. The replies reflect the split among states as to the need for a boundary between airspace and outer space, and they indicate that states believing that there is a customary international right of innocent passage for space objects are probably in the minority. The replies also reveal the uneasiness among some states regarding the applicability of the conventional term 'space object' to spaceplanes. The United States, which is probably the most advanced in developing spaceplanes, had not responded to the questionnaire as of this writing.

Question 1: Can an aerospace object be defined as an object which is capable both of travelling through outer space and of using its aerodynamic properties to remain in airspace for a certain period of time?[420]

To this question, Germany replied that because the term 'aerospace object' is not used in any international legal regulation, it preferred to use the term 'space transportation system' (STS), since that term is the one commonly used by states that have been developing hybrid vehicles. Germany pointed out that it will consider all STS's to be space objects. Because STS's are still in the development phase, Germany did not think it appropriate to try to define their properties, and proposed that the COPUOS Scientific and Technical Subcommittee be asked to study the matter. The Russian Federation agreed that spaceplanes will have defining characteristics other than just the ability to operate in airspace and in outer space. Therefore, they preferred that the focus be on whether the object in question was to be used for earth-to-orbit missions or earth-to-earth missions. In essence, the Czech Republic concurred with both Germany and Russia, stating that the term 'aerospace object' should only be used as a working definition, and that consideration must be given to the destination of the

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[420] U.N. Doc. A/AC.105/635, *supra* note 197, at Question 1. The Republic of Korea thought that clarification of the definition was needed, but concluded that it, in principle, was appropriate. Mexico thought it more appropriate to apply the term 'aerospace object' only to earth-to-earth vehicles. Italy preferred that no definition be attempted until more was known about the technical aspects of these objects, since technology was continually evolving.

object when it takes off. Iraq, Pakistan, and the Philippines believed that the definition was adequate.

Question 2: Does the regime applicable to the flight of aerospace objects differ according to whether it is located in airspace or outer space?[421]

Germany responded that STS's are space objects subject to the space law regime. It acknowledged, however, that the operators of these systems had to be cognizant of air traffic regulations and take precautions to avoid collision when traversing the navigable airspace. Italy pointed out that aerospace objects are usually conceived with a unitary function in mind--space operations--therefore, only the space law regime should apply, regardless of the location of the object. Iraq, Pakistan, the Philippines, the Republic of Korea, and the Russian Federation believed that the regime will differ depending on the location of the object.

Question 3: Are there special procedures for aerospace objects, considering the diversity of their functional characteristics, the aerodynamic properties and space technologies used, and their design features, or should a single or unified regime be developed for such objects?[422]

The Czech Republic stated that unless a special regime is developed for these objects, they will be subject to two different regimes. However, it did not think it appropriate to develop a new regime at this point in the technological development of these objects. The Czechs also pointed out that it was possible that in practice, states would hold the objects to only one regime, even if the object spent time in both airspace and outer space. Germany pointed out that no special regime has been needed

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[421] *Id.* at Question 2. The Czech Republic believed that the question was not worded clearly, but did state that its answer would be 'yes' if the object moving in airspace was based on aeronautical technology and the object moving into orbit was based on astronautical technology. Mexico pointed out that the "differences with regard to the regime applicable under each of the conditions of flight relate both to the delimitation of outer space and to the rights of States over their airspace." *Id.*

[422] *Id.* at Question 3. The answer listed for Pakistan was non-responsive. Iraq stated that "single or multiple regimes should be developed to cover all aspects involved." Italy suggested that the question be rephrased because it "lacks juridical value," and pointed out that its response to Question 2 indicated that Italy views aerospace objects as being subject to a unitary regime. *Id.*

until now since the only operational STS, the U.S. Space Shuttle, was not known to cross foreign airspace during re-entry. They believed that this question, however, should not be answered without input from the Scientific and Technical Subcommittee. The Republic of Korea stated that no special regime currently exists, and that it favored a unified regime in order to take into consideration the diverse functional characteristics of aerospace objects. Russia also stated that no special regime currently exists for aerospace objects, and that one might be needed in order to take into consideration their special features. Mexico and the Philippines believed that a unified regime should be developed.

Question 4: Are aerospace objects while in airspace considered as aircraft, and while in outer space as spacecraft, with all the legal consequences that follow therefrom, or does either air law or space law prevail during the flight of an aerospace craft, depending on the destination of such a flight?[423]

The Czech Republic responded that the object is an aircraft when in airspace and a spacecraft when in outer space—but only as regards truly hybrid vehicles capable of conducting sustained operations in either location. As regards vehicles that are used either for earth-to-orbit or earth-to-earth missions, they believed that the vehicle must be considered either as a spacecraft or an aircraft, respectively, even if the vehicle spent a short amount of time in one domain. Germany once again stated their belief that space law applies regardless of the location of the STS, but that air traffic rules would have to be observed for safety purposes. The Philippines concurred that space law applies to aerospace objects whose ability to maneuver in airspace is only incidental to their space function. Iraq and the Republic of Korea opined that the location of the object determines whether it is an aircraft or a spacecraft. Mexico and Pakistan pointed out that air law would apply to objects in the airspace, but suggested that a special regime may be needed for aerospace objects. Russia stated that the purpose of an

[423] *Id.* at Question 4. Italy suggested that the question be rephrased because it "lacks juridical value," and pointed out that its response to Question 2 indicated that Italy views aerospace objects as being subject to a unitary regime.

object's flight could be used as the criterion to determine the applicable legal regime, but stated that a new regime might be needed for aerospace objects.

Question 5: Are the take-off and landing phases specially distinguished in the regime for an aerospace object as involving a different degree of regulation from entry into airspace from outer space orbit and subsequent return to that orbit?[424]

Pakistan and the Philippines responded 'yes.' The Czech Republic stated that objects with a unitary function, such as the U.S. Space Shuttle, should be subject to just one regime—space law. However, if the vehicle in question was truly hybrid and could perform equally in airspace and outer space, then the vehicle should conform to air law when in airspace and to space law when in outer space. Germany reiterated that no problems have yet arisen that would require resolution of this issue, nevertheless, they stated that their response to Question 2 still applied—that STS's are space objects subject only to space law, with consideration shown for air traffic laws. However, if a special regime is developed for STS's, then it believes that a distinction must be made between the landing and take-off phases. In Mexico's view, there was no need for different regulations. The Russian Federation responded that new norms of international space law were necessary to regulate these aspects of the regimes governing aerospace objects. The Republic of Korea stated that there is currently no special regime distinguishing between the takeoff and landing phases of flight instrumentalities, but noted that if an object passed through a foreign state's airspace, then appropriate international and domestic laws would apply.

Question 6: Are the norms of national and international air law applicable to an aerospace object of one State while it is in the airspace of another State?[425]

Iraq, Mexico, and the Philippines said 'yes.' The Republic of Korea and the Czech Republic said 'yes,' so long as the object in question is a truly hybrid aerospace

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[424] *Id.* at Question 5. Iraq requested that this question be clarified. Italy also requested that the question be rephrased, and pointed out its belief, as stated in its response to Question 2, that the objects are subject to a unitary regime—space law.

[425] *Id.* at Question 6.

object. Germany referred to its responses to Questions 2 and 4—that it believes STS's are space objects subject only to space law, with consideration shown for air traffic laws. Italy stated that it could not say 'yes' in light of the unitary character of the object's mission, but nevertheless said that the rules of air navigation had to be observed to avoid interference. Pakistan believed that a boundary between airspace and outer space was needed before this question could be answered, since under the present legal regimes, states cannot clearly determine how far up their authority extends. The Russian Federation recommended that a new treaty be completed that codifies as a norm the right of peaceful passage through foreign airspace. They believed that such a codification would remove the need for earth-to-orbit aerospace objects to try to meet varying air law requirements.

Question 7: Are there precedents with respect to the passage of aerospace objects after re-entry into the Earth's atmosphere and does international customary law exist with respect to such passage?[426]

The Russian Federation responded that "[t]here are such precedents." Its delegate stated that an international practice among states has been evolving whereby states agree that their sovereignty does not extend above the lowest perigee of artificial satellites (approximately 100 km), and that, although passage of space objects over foreign airspace below that altitude rarely occurs, the launching state generally notifies the overflown state as a courtesy when such overflight will occur.[427] Russia also believes that provisions for customary international law "are being elaborated" with respect to innocent passage for re-entering space objects. Mexico and Pakistan agreed that there are precedents, such as objects falling into the territories of Canada (the Soviet Cosmos 954) and Australia (the American Skylab). Pakistan added that it was

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[426] *Id.* at Question 7. Italy stated that "the issue should be re-examined keeping (sic) into account solutions mentioned" in Questions 2 and 6.

[427] *Id.* The Russian Federation stated that in 1990, the United States, as a gesture of goodwill, notified the USSR that an American space object would be re-entering earth's atmosphere over Soviet territory and would be at an altitude below 100 km. The Russian Federation acknowledged that the U.S. did not provide the information out of any belief that it was required to do so, and that both parties agreed the incident did not establish a precedent.

unaware of the existence of a specific international customary law regarding passage of aerospace objects over foreign territories. Iraq and the Philippines stated that they were not aware of any precedents. The Czech Republic stated that there is no evidence that a customary rule of international law has developed regarding the passage of space objects over foreign territories. However, it pointed out that such passage does occur, and that in light of the absence of protests from the overflown states, it might be appropriate to legalize such passage and regulate it. The Republic of Korea stated that there were no international customary laws or precedents regarding passage of space objects through foreign airspace. It held that the lack of objection from states to the overhead passage of space objects does not amount to approval of such, nor does it amount to an international practice or precedent. Germany said that no international customary law exists allowing STS's to pass over foreign territories. Its delegate pointed out the fact that the Soviet shuttle Buran overflew foreign territory during its one and only return flight, but that this one precedent could not establish a rule of customary international law.

Question 8: Are there any national and/or international legal norms with respect to the passage of space objects after re-entry into the Earth's atmosphere?[428]

According to the Czech Republic, there are no specific rules applicable, but that the general principles set out in the 1967 Outer Space Treaty applied. Mexico agreed, calling attention also to the 1968 Rescue Agreement, the 1972 Liability Convention, and the 1974 Registration Convention. Pakistan concurred with the Czech Republic that there are probably no specific national or international legal norms that cover the matter. It also agreed with Mexico that the general principles of such documents as the 1967 Outer Space Treaty and the 1968 Rescue Agreement were relevant. Germany referred back to its responses to Questions 1, 2, and 4, and also outlined several of its national laws that it believed were applicable.

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[428] *Id.* at Question 8. Iraq's reply was non-responsive. Italy, the Republic of Korea, and the Russian Federation did not respond. The Philippines stated that it was not aware of any legal norms in its national regime that were applicable.

Question 9: Are the rules concerning the registration of objects launched into outer space applicable to aerospace objects?[429]

Germany, Iraq, Mexico, and Pakistan said 'yes.' The Czech Republic stated that those aerospace objects that are essentially space objects must be registered according to space law, whereas truly hybrid vehicles should be subject to double registration unless a new regime is developed for them. The Republic of Korea does not believe that the term 'space object' as defined in the Registration Convention includes aerospace objects. They recommended that a new registration procedure be implemented for these objects. The Philippines stated that aerospace objects should be subject to a new registration regime. The Russian Federation responded that although it might one day be useful to develop a new registration regime for aerospace objects--especially so that notice of their projected flight paths over foreign territory could be provided--it was premature for now to change the current registration requirements. They recommended that the question be revisited when more information was available on the technical features of aerospace objects.

[429] *Id.* at Question 9.

CHAPTER V
The Implications of Spaceplanes For the Boundary and 'Space Object' Issues

In 1962, commenting on new space-related technology such as the X-15, United States Air Force Major General Albert M. Kuhfeld said,

> As we cross the threshold into these many new space activities, you as attorneys, are of course aware that the law must keep pace. Our dilemma, however, is whether in this new advance of man's evolution we shall have laws by sufferance or whether we can keep pace with space progress and intelligently discern in what areas law should now be made and in what areas there yet remain too many scientific round pegs and square holes that do not yet readily lend themselves to formulation of firm principles of governing law.[430]

Today, seventeen years after the first U.S. Space Shuttle flight into outer space, ten years after the orbital flight of the Soviet shuttle Buran, and as NASA and Lockheed Martin Corporation plan to conduct test flights of their X-33 next year, spaceplanes are still considered by some to be round pegs which do not fit squarely into either the air or space legal regimes. The interest that some states have shown in developing spaceplanes of their own has caused other states and some jurists to call for resolution of the boundary issue and/or development of a clear legal definition into which hybrid vehicles such as spaceplanes will fit--all in an attempt to make it easier to determine under which legal regime such instrumentalities fall.

Most legal issues raised by the advent of spaceplanes will likely disappear if a boundary between airspace and outer space is established and if the definition of 'space object' is agreed upon. But in this author's opinion, spaceplanes will not require a new legal regime, nor will they require resolution of the boundary issue, nor a more precise definition of space objects. As well, they will not require creation of a new category (such as 'aerospace objects'), nor will they need a right of innocent passage.

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[430] A. M. Kuhfeld, "Across the Space Threshold," IV *JAG Bulletin* 3, 7 (Sept.-Oct. 1962).

A. Spaceplanes Will Not Require a *Sui Generis* Legal Regime

As indicated in earlier chapters, in order to avoid the need to address the definitional questions raised by the current air and space legal regimes, some states,[431] and jurists[432] have proposed that a separate legal regime be developed for hybrid instrumentalities such as spaceplanes. Primarily, it is believed that a new legal regime should provide special registration requirements and liability rules for spaceplanes—with liability provisions probably being the most important consideration. In this author's opinion, it is unrealistic to think that states will develop a new regime for spaceplanes, and, in any case, it is unnecessary for such a regime to be developed.

1. It is Impractical to Think a New Regime Would be Possible or Helpful

It is unlikely that all space powers and the majority of states will agree to a separate legal regime for spaceplanes. Since the early days of the space age, when states began developing the space law regime, it has been fairly difficult for states to agree on detailed treaty provisions in this area.[433] The umbrella 1967 Outer Space Treaty, which contains general principles regarding space activities, has more parties than the more detailed treaties that followed it and elaborated several of its principles. Indeed, each later treaty has garnered fewer parties than the treaty that preceded it.[434] As far as the development of the law of outer space is concerned, states are nowadays reluctant to enter into treaties, opting instead to express agreement in the form of non-binding U.N. General Assembly resolutions.[435]

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[431] *See supra* note 197, at Question 3.

[432] *See, e.g., supra* notes 381-83 and accompanying text.

[433] The discussion in Chapter IV, above, of some of the debates during the drafting of the Liability Convention, illustrates some of the difficulties encountered.

[434] As of January 1997, the number of ratifications received by each of the five space law treaties was as follows: 1967 Outer Space Treaty: 93; 1968 Rescue Agreement: 83; 1972 Liability Convention: 76; 1974 Registration Convention: 39; 1979 Moon Treaty: 9. *Space Law and Institutions: Documents and Materials*, I.A. Vlasic, ed. (Montreal: McGill Univ., 1997) 173.

[435] The 1979 Moon Treaty (Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, U.N. Doc. A/RES/34/68, 5 Dec. 1979) was the last binding space law agreement

The exact reason(s) for the inability of states to express their agreement in treaty form regarding outer space matters is not known. It could be because the membership of UN COPUOS has ballooned from the original 24 members to the current 61 members,[436] making it more difficult for that body to reach consensus. Or it could be, as Dr. Jasentuliyana suggested, because some delegates lack the necessary legal, technical, and/or background knowledge to understand the implications of some of the positions they take on issues, or that they lack authority to make decisions on behalf of their governments.[437] In addition, for any treaty proposal to gain general acceptance, the major space powers must support it.[438] Thus, unless the United States joins the call for a new legal regime for hybrid vehicles, it is unlikely that such a regime will ever materialize. And there has been no indication that the United States, the state that is probably the most advanced in developing spaceplanes, believes that such instrumentalities will require a special legal regime.

Another factor pointing to the impracticality of pursuing a new legal regime is that, unless it obtains widespread ratification by states, the regime would do little to resolve the perceived shortcomings of the current legal regimes. It is probable that this

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completed by states. Since then, additional principles of space law have been expressed in such resolutions as the Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of all States, Taking Into Particular Account the Needs of Developing Countries, U.N. Doc. A/RES/51/122, 13 Dec. 1996; Principles Relevant to the Use of Nuclear Power Sources in Outer Space, U.N. Doc. A/RES/47/68, 14 Dec. 1992; Principles Relating to Remote Sensing of the Earth From Outer Space, U.N. Doc. A/RES/41/65, 3 Dec. 1986; and Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting, U.N. Doc. A/RES/37/92, 10 Dec. 1982. *See also* G.C. Sgrosso, "Must the Special Typology of Aerospace Planes Lead to the Supplementation of the Rules of the Outer Space Treaty?" *Proceedings of the Fortieth Colloquium on the Law of Outer Space* (Reston, VA: AIAA, 1998) 402, 408 [hereinafter Sgrosso] (saying that "States do not wish to give up their exclusive competence on the subject [of the regulation of space matters] and in order not to slow down the space activities further they prefer to regulate the situations with specific agreements between the parties, as for the International Space Station.").

[436] U.N. COPUOS, "COPUOS - History," http://www.un.or.at/OOSA/copuos1.html (accessed: 16 July 1998).

[437] N. Jasentuliyana, "The Lawmaking Process in the United Nations," *excerpted in Space Law and Institutions: Documents and Materials*, I.A. Vlasic, ed. (Montreal: McGill Univ., 1997) 91, 92.

[438] *Id.* at 92.

spaceplane regime would have different and/or fewer parties than the other major space law treaties. Thus, the spaceplanes of one state conceivably could be subject to a different legal regime than the spaceplanes of another state. The alleged legal confusion that currently exists that proponents of a third regime hope to avoid, therefore, still would be present unless and until the new regime's provisions evolved into customary international law.

2. The Current Legal Regimes Adequately Address Spaceplanes

Some of the basic questions raised by spaceplanes are: are they space objects, subject only to space law; are they aircraft, subject only to air law; or should their location at any given point determine the applicable law? One factor complicating the answer to these questions is the different configurations envisioned for spaceplanes.

i. Vertical Takeoff, Horizontal Landing Vehicles. The VTHL vehicles, such as the U.S.'s X-33 and Japan's HOPE, will likely be considered space objects, like the U.S. Space Shuttle. The FAA's analysis of the space shuttle's status and its conclusion that the shuttle should be registered as a space object rather than as an aircraft is persuasive.[439] VTHL vehicles make minimal use of airspace en route to outer space due to their direction of takeoff. Their only purpose, generally, is to perform operations in outer space. Therefore, their use of airspace upon return from outer space, albeit for a longer period of time than when they take off due to their horizontal position, is purely incidental. Under these circumstances, there is no reason to apply any regime other than space law to these vehicles from the moment they are launched to the moment they are returned to their launching state.[440] Hence, they should be registered as space objects, and they should be subject to the Liability Convention. Of course, just as the FAA requires of the U.S. Space Shuttle, these VTHL space objects

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[439] *See supra* notes 384-86 and accompanying text.

[440] *Accord* Wassenbergh, *supra* note 200, at 55; C. Zanghi, "Aerospace Object," *Outlook on Space Law Over the Next 30 Years*, G. Lafferranderie and D. Crowther, eds. (The Hague: Kluwer, 1997) 115, 119 [hereinafter Zanghi]; Christol, *supra* note 303, at 28; Masson-Zwaan, *supra* note 200, at 248; Haanappel, *supra* note 381, at 342.

should respect local air traffic regulations to ensure that measures are taken to avoid collision with aircraft.[441]

ii. Vertical Takeoff, Vertical Landing Vehicles. VTOL vehicles such as the DC-XA, likewise, should be considered space objects. They spend even less time in airspace than VTHL vehicles due to their return to earth in a vertical, rather than horizontal, position. Their missions will likely only be space operations. Space law should apply to VTOL vehicles from launch until their return to the launching state.[442] They should be registered as space objects, which would subject them to the Liability Convention. Like the VTHL spaceplanes, these instrumentalities must nevertheless respect local air traffic laws.

iii. Horizontal Takeoff, Horizontal Landing Vehicles. HTOL spaceplanes pose somewhat of a dilemma. These vehicles will spend more time in airspace than VTHLs due to their horizontal takeoff and horizontal landing positions. These are the spaceplanes that are often conceived for use with conventional airport runways. In addition, HTOL spaceplanes are usually envisioned for both earth-to-orbit and earth-to-earth missions, thus rendering them truly hybrid vehicles. Examples of HTOL concepts include the German 'Sänger' and DSL;[443] the British HOTOL and Skylon; the French STAR-H; and the Pathfinder and aerospacecraft vehicles planned by the American companies Pioneer Rocketplane and Space Access. Following the rationale of the FAA's functional approach to determining the status of the space shuttle, if these vehicles are to be used for earth-to-earth, international civil aviation purposes, then air law should apply.[444] Therefore, prior authorization would be required to traverse the

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[441] *See supra* note 386.

[442] *Accord* Wassenbergh, *supra* note 200, at 55; Zanghi, *supra* note 440, at 119; Christol, *supra* note 303, at 28; Masson-Zwaan, *supra* note 200, at 248; Haanappel, *supra* note 381, at 342.

[443] *See supra* note 116 ('DSL' was the name of a now-defunct German program for a space transportation system. The acronym was retained for a current German project, but it has no official meaning today.).

[444] *Accord* Wassenbergh, *supra* note 200, at 54-55; Christol, *supra* note 303, at 28; Masson-Zwaan, *supra* note 200, at 248; Haanappel, *supra* note 381, at 341.

airspace of foreign states, and the airworthiness and registration requirements of the Chicago Convention will apply. Even if these hypersonic vehicles spend a portion of their voyage in outer space, such use of outer space should only be considered incidental to the vehicle's primary mission—transport from one point on earth to another. There is no reason to apply space law when the vehicle's purpose is not to conduct missions in outer space.[445] As regards military spaceplanes, the Chicago Convention would not apply, but other customary air law requirements, such as permission to enter foreign airspace, would apply to these vehicles.

The space law regime should apply whenever an SSTO HTOL is used for earth-to-orbit missions, and it should apply from the moment of launch until the vehicle's return to the launching state. Hence, these vehicles should be registered under the Registration Convention. The rationale for applying the space law regime, once again, is because the primary purpose of the vehicle is to conduct operations in outer space, and the vehicle's use of airspace in carrying out this mission is purely incidental. Even HTOLs that are capable of being maneuvered while in airspace due to powered takeoffs and powered returns should be considered space objects subject to space law. While in airspace, these vehicles will have to respect the airspace sovereignty and air traffic laws of foreign states, but this does not justify a requirement that they be registered as aircraft.

It is primarily the multiple-staged HTOL that would use an aircraft as the first stage that causes concern. HTOLs like the DSL and the reconfigured Interim HOTOL would be air-launched from aircraft. In this situation, the question arises whether the aircraft stage would fall within the definition of 'space object' as a 'launch vehicle.' States will have to determine whether the aircraft should be viewed as akin to a launch

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[445] This conclusion is in keeping with the Registration Convention, which only requires the registration of objects that go into orbit, and, presumably, spaceplanes on earth-to-earth missions will not go into orbit while using space for part of the trip. This conclusion also highlights the fact that there are no 'space traffic control systems'. It will be interesting to see whether such systems will be developed one day as spaceplane flights become as commonplace, though probably not as numerous, as aircraft flights.

pad, which is not considered to be a space object; or whether it is to be considered as performing the same function as booster rockets, which are space objects.

In resolving this issue, it may be helpful to look at how the United States defines certain terms. The U.S. Commercial Space Launch Act does not define 'launch pad,' but it does define 'launch site' as "the location on Earth from which a launch takes place . . . and necessary facilities at that location."[446] It defines 'launch property' as " an item built for, or used in, the launch preparation or launch of a launch vehicle."[447] 'Launch vehicle' is defined as "(A) a vehicle built to operate in, or place a payload in, outer space; and (B) a suborbital rocket."[448] The carrier aircraft would not fall within this statutory definition of 'launch vehicle' because it will do nothing to actually propel the spaceplane into orbit. Instead, the spaceplane is designed to use rocket engines to reach outer space after release from the aircraft. Therefore, from the U.S. perspective, it would appear that an aircraft used to launch a spaceplane would fall within the definition of 'launch property'--which apparently is not the same as a 'launch vehicle'--and would not be considered a 'space object' under the Liability and Registration Conventions.

One might also ask whether the first stage carrier aircraft is a 'component part' of the space object it transports. Recall that the space treaties' definition of 'space object' "includes component parts of a space object as well as its launch vehicle and parts thereof."[449] *The Concise Oxford Dictionary* defines 'component,' when used as an adjective as in the Liability and Registration Conventions, as "being part of a larger whole (*assembled the component parts*)."[450] Considering both of these definitions

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[446] 49 U.S.C.S. § 70102 (6) (Law. Co-op., 1997).

[447] 49 U.S.C.S. § 70102 (4) (Law. Co-op., 1997).

[448] 49 U.S.C.S. § 70102 (7) (Law. Co-op., 1997).

[449] Liability Convention, *supra* note 209, at Article I; Registration Convention, *supra* note 210, at Article I.

[450] *The Concise Oxford Dictionary of Current English*, R.E. Allen, ed. (Norwalk, CT: The Easton Press, 1993) 233 (italics in original).

together, the 'whole' would be the spaceplane itself—the space object. However, the carrier aircraft cannot reasonably be considered a 'part' that helps constitute the spaceplane.[451] If anything, the carrier aircraft should be viewed in the same vein as objects like sounding rockets and intercontinental ballistic missiles, which do not go into orbit and, therefore, are not registered as space objects.[452] Nor should the aircraft be viewed as a part of the launch vehicle. Spaceplanes are conceived as having rocket engines as their launch mechanism, and the aircraft would not be part of these engines.

National definitions, of course, are not binding internationally. Nevertheless, it makes sense to view the first stage carrier aircraft in this situation as a conventional aircraft that would be subject only to air law. It should be considered as any other aircraft transporting cargo, the major difference being that the cargo is unloaded in airspace, rather than on the ground.

The foregoing issue is related to another question raised by some jurists, and that is, has an SSTO vehicle that takes off horizontally been 'launched?'[453] The question is significant because, under space law, states are only required to register objects that have been *launched* into earth orbit or beyond.[454] None of the space law instruments defines the term 'launch.'[455] The U.S. Commercial Space Launch Act defines 'launch' as "to place or try to place a launch vehicle and any payload—(A) in a suborbital trajectory; (B) in Earth orbit in outer space; or (C) otherwise in outer

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[451] *Accord* Zanghi, *supra* note 440, at 120; Sgrosso, *supra* note 435, at 405. *Contra* Hashimoto, *supra* note 5, at 379 (saying that the first stage of the spaceplane, even if it is an aircraft, should be considered a component part because it is a necessary part of the object's ability to reach orbit).

[452] *See* H. Qizhi, "Review of Definitional Issues in Space Law in the Light of Development of Space Activities," *Proceedings of the Thirty-fourth Colloquium on the Law of Outer Space* (Washington, D.C.: AIAA, 1992) 32-33.

[453] *See, e.g.*, Wassenbergh, *supra* note 200, at 55-56 (indicating that a spaceplane that takes off by itself is not 'launched' as that term is used in the space law regime).

[454] Registration Convention, *supra* note 210, at Article II.1.

[455] The Liability Convention does say "[t]he term 'launching' includes attempted launching." Liability Convention, *supra* note 209, at Article I (b).

space."[456] *The Concise Oxford Dictionary* defines 'launch' as, *inter alia*, to "set (a vessel) afloat," and to "hurl or send forth (a weapon, rocket, etc.)."[457] It does not appear from either of these definitions that a vertical trajectory is required for an act to constitute a launch. Therefore, one should consider an SSTO HTOL spaceplane to have been launched when it takes off on an outer space mission. Thus, under such circumstances, it should be treated as a space object. On the other hand, if the vehicle is being used for earth-to-earth missions, then it should be considered an aircraft, and it should be registered as such, and the same goes for VTOL and VTHL spaceplanes that might be used for other than earth-to-orbit purposes.

If a spaceplane will at times be used for earth-to-orbit missions, and at other times for earth-to-earth missions, then the vehicle should be registered as both a space object and as an aircraft. Such dual registration has been advocated by some jurists,[458] but is subject to criticism as being complicated and apt to lead to confusion, especially when the appropriate liability regime must be determined. Recall that under space law, a space object that causes damage to a conventional aircraft in flight would subject the launching state to absolute liability.[459] An aircraft that causes damage to a conventional aircraft in flight would be subject to liability according to the appropriate national law because there is no international agreement that covers this situation. If the national liability scheme is fault-based, and the vehicle in question has been registered as an aircraft, but at the time was being used as a space object whose launching as such had not yet been registered, a victim may be left with proving fault if the launching state does not admit that the situation calls for absolute liability.

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[456] 49 U.S.C.S. § 70102 (3) (Law. Co-op., 1997).

[457] *The Concise Oxford Dictionary of Current English*, R. E. Allen, ed. (Norwalk, CT: The Easton Press, 1993) 669.

[458] *See, e.g.*, Masson-Zwaan, *supra* note 200, at 261.

[459] Liability Convention, *supra* note 209, at Article II.

Nevertheless, these claims of confusion are not compelling enough to veto the idea of dual registration. Concerns about dual registration--and concerns about what the mission of the spaceplane was--would probably only arise in the context of a disputed liability claim. Unless that claim is settled, then, through information obtained during an orderly dispute process, one should be able to learn enough about the purpose of the vehicle in question to ascertain whether it was acting as a space object or an aircraft at the time it caused the damage, and therefore, be satisfied as to the applicable legal regime. This should be the result regardless of whether the claim is brought initially against the state or against the vehicle's operator.

B. Spaceplanes Will Not Require Establishment of a Boundary Between Airspace and Outer Space

At this point, it is important to remember that the purpose of this thesis is not to debate the merits of the various proposals for a boundary between airspace and outer space. Instead, its purpose is to analyze the impact that spaceplanes will have on this issue. Chapter III revealed the concern of some states and jurists that the advent of spaceplanes will require resolution of the boundary question. This author does not share that view.[460] Instead, she believes that as far as spaceplanes are concerned, the matter of a boundary is a non-issue. The very nature of truly hybrid spaceplanes renders a boundary between airspace and outer space irrelevant. These instrumentalities will be able to move freely in both domains. A demarcation will do little to clarify their legal status. If a spaceplane is used *only* for outer space operations, or *only* for earth-to-earth missions, then a boundary might be helpful in enabling other states to determine the applicable legal regime, but it is not necessary for that purpose, as was shown in Part A of this chapter, and would do little for

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[460] *Accord* Christol, *supra* note 303, at 29; Hintz, *supra* note 393; I.I. Kuskuvelis, "The Aerospace Plane: In the Direction of an Aerospace Law," *Proceedings of the Twenty-ninth Colloquium on the Law of Outer Space* (New York: AIAA, 1987) 175, 178.

determining the regime applicable to a truly hybrid spaceplane used for both types of missions.

Professors Cheng and Goedhuis made valid arguments that the location of a vehicle must be known in order to determine whether a particular activity is legal.[461] In essence, their argument is that if a spaceplane is passing over a foreign state, it would be helpful to know whether it is passing through national airspace or through free outer space. That is because, for the former, prior authorization is required. But once again, although a boundary would be helpful for making this determination, it is not necessary.

By asserting that the location of a vehicle should determine the applicable legal regime, one ignores the hybrid nature of spaceplanes.[462] It would not be logical to apply international air law, or national, liability regimes to a spaceplane just because it happened to become involved in an accident in airspace while en route to or from outer space. The Liability Convention adequately covers such situations. If the spaceplane was on a space mission, and collided with an aircraft in airspace or caused damage on earth, then it should be subject to that Convention's absolute liability requirements. If the spaceplane was conducting an earth-to-earth mission and collided with a conventional aircraft or caused damage on the surface of the earth, then the international air law, or national, liability regimes would apply. There may be a dispute as to whether the spaceplane was operating as an aircraft or as a space object, but a boundary between airspace and outer space would not resolve that dilemma. That is because it is a given that space objects must traverse airspace en route to and from outer space. To set a boundary and say that any object operating below that boundary is an aircraft would fly in the face of the outer space regime.

It has not escaped this author's attention that the Liability Convention's regime turns in part on location—but not on the location of the space object that causes

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[461] *See supra* notes 300-02 and accompanying text.

[462] *Cf.* "The aerospace plane," *supra* note 303, at 41 (Professor Christol states that the functional approach to the boundary issue ignores the hybrid nature of spaceplanes because they could have more than one function.).

damage. That Convention's liability regime turns on the location of the victim. To determine whether the launching state's liability will be fault-based or absolute, one primarily needs to know whether the victim was on earth, was an aircraft in flight,[463] or was a space object located elsewhere than on the surface of the earth.[464] The space object that causes the damage could have been located in airspace or in outer space at the time of the accident involving persons or property on earth or an aircraft in flight, but the liability will still be absolute. The space object could have been in airspace or in outer space when it damaged another space object that was elsewhere than on the surface of the earth, and the liability will still be fault-based. Therefore, a boundary indicating whether the space object that caused the damage was operating in airspace or outer space at the time of the accident would be irrelevant to determining the nature of the launching state's liability.

The security concerns of states as regards the lack of a boundary certainly could be magnified by the advent of spaceplanes. These hypersonic vehicles could be used to rapidly enter another state's territory to conduct surveillance or other military operations without permission from the state to do so. Likewise, the fears that spaceplanes could be used by some states to rapidly overfly another state's territory without authorization are valid. However, a boundary between airspace and outer space would neither prevent these types of activities from occurring, nor render them any more unauthorized than they already are.

Those who say that a boundary is not meant to salve a state's security or sovereignty fears but to enable spaceplane operators to know the bounds within which they are authorized to travel freely probably make the best argument for demarcating airspace from outer space. In the absence of a boundary, states will have to rely on the

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[463] That is, the aircraft is in airspace. If and when aircraft are developed that can travel through outer space, they should then be referred to as spaceplanes, and treated like the HTOL spaceplanes discussed in Section A.2.iii of this chapter.

[464] The damaged space object that was elsewhere than on the surface of the earth could have been in airspace or in outer space.

integrity of the spaceplane operator not to intrude into their airspace. But also, in the absence of a boundary, how is the operator to know whether it is about to intrude into foreign airspace? How is he or she to know for certain that he or she is operating in outer space? A boundary would certainly answer those questions. (Another answer to the questions would be the implementation of a right of innocent passage for space objects. This aspect is dealt with in Section D of this chapter.) Nevertheless, this author does not believe that attempting to establish a boundary between airspace and outer space is the best solution. As several jurists and states have argued, any boundary selected (such as 100 km) will necessarily be arbitrary. There is no stable means of delimiting airspace except by selecting an arbitrary altitude, since the physical properties of the airspace and atmosphere change over time. In this author's opinion, even if it was possible to select a stable physical aspect of the outer space/airspace environments as a boundary, it may be extremely difficult for states to agree on any limit to their sovereignty. Such unwillingness is one of the reasons why the member states of COPUOS have been unable to resolve the boundary issue.[465] For now, it is probably best to deal with the issue of spaceplanes by sufferance—to use General Kuhfeld's term. It may be that when spaceplanes become commonly used fixtures in both the space and air transport arenas states will decide that the time has arrived to settle on a boundary. Or perhaps they will agree on a minimum altitude below which spaceplanes cannot fly without authorization from applicable foreign states—an idea akin to the limited-purpose boundary proposed by some jurists. In the meantime, states should view spaceplanes in the same vein as they do orbiting satellites—as being in outer space unless and until something happens to alert states that there is a problem, such as no-notice, unauthorized crossings of foreign navigable airspace.

Lastly, and in spite of the foregoing discussion, the author believes that spaceplanes present an excellent reason for states to hold off on establishing a customary or conventional rule of international law that places a boundary between

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[465] *See, e.g., infra* note 478.

airspace and outer space at 100 km or at any other altitude. The USSR's proposal to codify 100-110 km as the boundary fortunately has not gained widespread support among member states of COPUOS, and there is no indication that the lack of support is based on a belief that a customary rule already exists but does not need to be codified. Instead, the lack of support seems to indicate an understanding that the lowest perigee of orbiting satellites—the theory upon which the 100 km proposals are generally based—will always be subject to change as technology improves the ability of objects to orbit at lower altitudes. To pick the lowest altitude achieved as of one point in time, or to select 100 km when there is evidence that space objects have orbited at lower altitudes, could, as the United States and the United Kingdom have long argued, impede the further progress of space activities. Spaceplanes able to fly freely through airspace and outer space are a very real reason for maintaining flexibility as regards demarcation between airspace and outer space. They bespeak the imprudence in advocating that states establish a boundary at 100 km, customarily or conventionally. Such a boundary might leave enough of a cushion of airspace for conventional aircraft, but it might not be low enough for spaceplanes to operate efficiently and escape claims of violation of airspace sovereignty.

C. Spaceplanes Will Not Require a New Definition

As discussed in Chapter IV, several states and jurists have, over the years, proposed definitions for the term 'space object' that presumably would enable one to quickly discern whether a vehicle would be subject to the space law regime. That chapter also discussed the U.N. COPUOS questionnaire wherein states were asked whether vehicles such as spaceplanes should be placed into a separate category of 'aerospace objects,' and they were asked to comment on a proposed definition for that term.[466] As with the boundary issue, the purpose of this thesis is not to debate the various proposals for definitions or determine whether there is a need for another

[466] *See supra* note 197, at Question 1.

definition as a general proposition. Instead, this thesis analyzes whether the advent of spaceplanes requires resolution of this issue. In this author's opinion, it will not.

The discussion in Part A.2 of this chapter regarding whether the configurations of spaceplanes require a new legal regime also addresses arguments that the configurations of spaceplanes require that a new definition be developed, so the points made in the earlier section will not be repeated here. Suffice it to say that the configurations of spaceplanes do not require a new definition. In addition to those arguments for a new definition, it is sometimes said that the difficulty distinguishing when a spaceplane is operating as a space object and when it is operating as an aircraft is grounds for a new definition of 'space object' or a new definitional category within which to place such vehicles. But new definitions, though useful, are not necessary.

The issue would most likely arise when liability must be determined,[467] and does present a strong argument for a more precise definition in that regard. To use a previous example, an aircraft colliding with another aircraft in airspace would be subject to a different legal regime than a space object colliding with a conventional aircraft in airspace. But as also stated earlier, problems will probably only arise when the parties are in dispute over a claim. Information regarding the nature of the instrumentality in question would normally become available during an orderly dispute resolution process. This would reveal to the parties the appropriate liability regime. Therefore, a new definition to clarify the status of spaceplanes is unnecessary.

D. Spaceplanes Will Not Require a Right of Innocent Passage

It appears that the bottom line reasons for the debates over whether there needs to be a boundary between airspace and outer space and a more precise definition that clearly covers instrumentalities such as spaceplanes are sovereignty and security

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[467] In this regard, the applicability of the Registration Convention and the Rescue Agreement does not turn on whether the vehicle was operating as an aircraft or as a space object. These instruments focus on whether the vehicle had been launched into outer space. *See* Registration Convention, *supra* note 210, at Article II; Rescue Agreement, *supra* note 213, at Article 5.3.

concerns. Thus, the issue of innocent passage must be addressed. As indicated in previous chapters, some states and jurists regard the notion of innocent (or peaceful) passage as one means of avoiding the issue of whether vehicles such as spaceplanes violate state sovereignty if they traverse foreign airspace without prior authorization.[468] As discussed in previous chapters, the former Soviet Union had implied that a right of innocent passage exists. The Russian Federation later reflected their adoption of this belief when they asserted that a right of innocent passage for space objects already exists, expressed their belief that such a right should be codified, and suggested that all that is left for states to determine is whether prior authorization must be obtained to cross foreign airspace during such passage.[469] However, they appeared to be backing away from this position when, in response to the question on the COPUOS questionnaire as to whether international customary law exists with respect to the passage through airspace of returning space objects, they stated that such "[p]rovisions . . . are currently in the process of being elaborated."[470] In support of this assertion, the Russian Federation's response to Question 7 of the questionnaire pointed out that, in 1990, an American space object crossed Soviet territory without prior authorization--but with contemporaneous notice--and without objection by the Soviet Union. They implied that this scenario was evidence of a state practice of engaging in, and allowing, innocent passage for space objects, even though they acknowledged that both the United States and the Soviet Union agreed that this event would not be considered a precedent.

The responses of the other states to the COPUOS questionnaire are more clearly in keeping with the general view that there is no international right of innocent

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[468] *See, e.g.*, M. Lachs, "Freedoms of the Air—The Way to Outer Space," *Air and Space Law: De Lege Ferenda*, T.L. Masson-Zwaan and P.M.J. Mendes de Leon, eds. (The Netherlands: Kluwer, 1992) 241, 245.

[469] *See supra* note 402 and accompanying text; *see also supra* notes 187-89 and accompanying text (stating the similar position of the Russian Federation's predecessor, the Soviet Union).

[470] *See supra* note 197, at Question 7 (response of the Russian Federation).

passage, either customary or conventional.[471] However, there are jurists who believe that such a right either exists, or that it is *de lege ferenda* and should become *de lege lata* at least for spaceplanes. For example, Professor Gorove recently stated that he has changed his position on the matter and has come to believe that the right of "safe passage to and from outer space has now attained the status of international customary law"[472] for aerospace objects functioning as spacecraft. Professor Gorove pointed to the apparent lack of objection from overflown states to the Soviet shuttle Buran's alleged crossing of their territory without prior authorization. He also mentions the courtesy notice the U.S. provided to the USSR when an American space object was about to cross Soviet territory in 1990, noting that the USSR did not voice or otherwise indicate objection to the crossing and did not warn the U.S. against future such intrusions.[473]

However, this author agrees with Professor Wassenbergh, who has stated that no customary rule of innocent passage exists just because there have been no objections expressed to the transit of foreign space objects through national airspace.[474] The relatively few incidents of space objects passing through foreign airspace cannot be considered sufficient to establish the 'practice of states' component of the process of establishing customary international law. This is especially so when one of those incidents, the COSMOS 954 case, resulted in a dispute during which Canada vehemently expressed objection to the 'intrusion' of the Soviet space object into Canadian territory. Moreover, there is no evidence that states failed to voice objection to the crossings out of a belief that they were legally obligated to allow the space objects to cross their airspace.

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[471] *See supra* note 197, at Question 7; *see also*, Masson-Zwaan, *supra* note 200, at 253.

[472] "Legal and Policy Issues," *supra* note 186, at 416. *Accord* Lachs, *supra* note 186, at 61 (stating that a right of innocent passage to and from outer space already exists as incidental to and necessary for the free use of outer space). *See generally, supra* note 186 and accompanying text.

[473] "Legal and Policy Issues," *supra* note 186, at 416.

[474] Wassenbergh, *supra* note 200, at 36; *see also* Kopal, *supra* note 373, at 64.

Innocent passage will probably never become *de lege lata* because states will not easily waive the principle of airspace sovereignty. Even in the area of international civil aviation, "open skies" agreements, which may or may not become widely used in the future, only allow access through airspace by prior agreement, either bilaterally or regionally. Thus, even this form of liberal access to airspace has its limitations and restrictions. In addition, while just about every state has aircraft that engage in civil aviation, and therefore are able to request and receive civil aviation-related concessions in return for access by foreign aircraft, only a relatively few states have plans, or have had plans, for spaceplanes. States without spaceplanes, or plans for such, may not be very open to allowing foreign spaceplanes liberal access to their airspace.[475] Those that do allow such access will probably demand some measure of *quid pro quo*, as they usually do in their international civil aviation bilateral agreements, which means that a prior written agreement authorizing the passage might be required.

One can also analogize to the Open Skies Treaty of 1992,[476] whereby states party agree to allow foreign states to conduct aerial inspections of the overflown state's military sites. But these excursions of state aircraft through foreign airspace require prior notification, and, of course, would be treaty-based.

It may be that the Russian Federation had the Open Skies Treaty in mind when it suggested via its draft aerospace questionnaire that states should determine whether prior notice is required for the innocent passage of aerospace objects. Nevertheless, codification of a right of innocent passage and the requirement of prior notice of such passage will only be worth the effort if a distinction is made between military spaceplanes and civil spaceplanes. As stated in Chapter II, one of the reasons states are

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[475] Illustrating the reluctance of states to allow spaceplanes liberal access to their territory is the agreement between the U.S. and Chile for emergency landing privileges for the U.S. Space Shuttle in Chilean territory. The agreement stipulates that if the U.S. makes more than two such landings in any given year, then Chile has the authority to terminate the agreement! U.S.-Chile Space Cooperation Agreement, *supra* note 36, at Article 20.C. *See also* van Traa-Engelman, *supra* note 9, at 77-78.

[476] Treaty on Open Skies, done at Helsinki on 24 March 1992, U.S. Senate Treaty Document No. 37, 102d Congress, Second Session (1992), ratified by the U.S. on 3 Dec. 1993. The treaty is reprinted at, for example, 4 *D.C.L.J. Int'l L. & Prac.* 195 (1995).

so adamant in asserting sovereignty over their superjacent airspace is national security.[477] Political sensitivities as regards military missions can be added as a reason rendering states reluctant to grant rights of innocent passage to aircraft. There is no reason to believe that states will be any less opposed to innocent passage for military spaceplanes. Indeed, in 1983, the Greek delegate to COPUOS pointed out that "[i]t would be difficult for his delegation to accept the right of innocent passage of a space vehicle when one could not be sure how innocuous such a vehicle was."[478] More than likely, states will continue to require prior authorization, and not merely prior notice, for transit of military vehicles. For now, it is difficult to say whether military spaceplanes will be physically distinguishable from civil spaceplanes. Even if they are, at the hypersonic rates of speed with which spaceplanes will travel, overflown states will probably have difficulty observing any distinctions. Thus, it is unlikely that states will codify or acknowledge the existence of a customary right of innocent passage, with or without notice, for any spaceplanes.

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[477] *See supra* notes 159, 165 and accompanying text; *see also*, Benkö, *supra* note 235, at 144 (pointing out that "there is no direct way of verifying the 'peaceful' or 'innocent' character or mission of any foreign spacecraft"); *accord* U.N. Doc. A/AC.105/C.2/SR.392, *supra* note 237, at 5 (the Greek delegate to COPUOS wondered "whether it would be . . . easy to distinguish between innocent and non-innocent passage in space").

[478] U.N. Doc. A/AC.105/C.2/SR.394, *supra* note 264, at 5 (he added that his country also could not "accept any principle that placed a vertical limit on its sovereignty").

CONCLUSION

The legal regime of outer space intentionally contains some provisions that are flexible, and on some matters is silent, primarily to accommodate later technological advances, and to accommodate different, but compatible, state interpretations and approaches to space matters. The lack of a boundary between airspace and outer space and the current international legal definition of 'space object' are two conspicuous examples of this silence and flexibility. States are debating whether these issues need to be resolved so that space activities continue without international incident as technology improves and as more parties become involved. Resolution of these matters would be useful for addressing several issues that may arise during the conduct of space activities. But although the hybrid nature of spaceplanes brings new vigor to the arguments, these instrumentalities do not add any more sense of urgency to the resolution of these issues than exists in their absence. The current air and space law regimes will adequately cover the advent of spaceplanes. As regards innocent passage, there is no reason why spaceplanes should have any more rights than civil aircraft to cross foreign territory.

Nevertheless, in addition to questions regarding which legal regime applies to them, spaceplanes will also raise questions regarding the status of the personnel on board—will they be considered astronauts or aircraft pilots, tourists, or soldiers? The term 'astronaut' also is not defined in the outer space treaties. And, as more private entities use spaceplanes, the question may arise whether the principle of state responsibility for national activities in outer space will need to be reassessed, or whether 'space traffic control' systems will need to be established to decrease the possibility of collisions between spaceplanes while in outer space. Thus, although spaceplanes will not bring the boundary and 'space object' issues to a head, they may serve as the catalyst states need to finally put those issues to rest, and to resolve some of the other matters the current space law regime does not address.

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